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U. S. Engineer dept.

Reports on Examination and Survey of Etowah, Coosa, Tallapoosa and Alabama Rivers

(GEORGIA AND ALABAMA)

LETTER FROM
THE SECRETARY OF WAR

TRANSMITTING

WITH A LETTER FROM THE CHIEF OF ENGINEERS,
REPORTS ON EXAMINATION AND SURVEY OF
ETOWAH, COOSA, TALLAPOOSA, AND
ALABAMA RIVERS, GEORGIA
AND ALABAMA

OCTOBER 16, 1913.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations

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ETOWAH, COOSA, TALLAPOOSA, AND ALABAMA RIVERS, GA. AND ALA.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON EXAMINATION AND SURVEY OF ETOWAH, COOSA, AND TALLAPOOSA RIVERS, GA. AND ALA., WITH A VIEW TO THEIR IMPROVEMENT FOR NAVIGATION, INCLUDING THE ALABAMA RIVER IN CONNECTION THEREWITH, AND INVESTIGATIONS NECESSARY TO DETERMINE WHETHER STORAGE RESERVOIRS AT THE HEADWATERS OF SAID RIVERS CAN BE UTILIZED TO ADVANTAGE AND WHAT PORTION OF THE COST OF ANY SUCH IMPROVEMENTS, INCLUDING RESERVOIRS, SHOULD BE BORNE BY OWNERS OF WATER POWER AND OTHERS.

October 16, 1913.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations.

War Department,
Washington, October 11, 1913.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated 9th instant, together with copies of reports from Capt. (now Maj.) H. B. Ferguson, Corps of Engineers, dated June 1, 1909, and June 10, 1910, with maps and appendixes, on preliminary examination and survey, respectively, of Etowah, Coosa, and Tallapoosa Rivers, Ga. and Ala., made by him in compliance with the provisions of the river and harbor act approved March 3, 1909.

Very respectfully,

Lindley M. Garrison,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, October 9, 1913.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of Etowah, Coosa, Tallapoosa and Alabama Rivers, Ga. and Ala.

1. There are submitted herewith, for transmission to Congress, reports dated June 1, 1909, and June 10, 1910, with maps and appendixes, by Capt. (now Maj.) H. B. Ferguson, Corps of Engineers, on preliminary examination and survey, respectively, made pursuant to the following item contained in the river and harbor act approved March 3, 1909:

> Etowah, Coosa, and Tallapoosa Rivers, with a view to their improvement for navigation. Such examination for the improvement of the navigation of said rivers, including the Alabama River in connection therewith, shall include investigations necessary to determine whether storage reservoirs at the headwaters of said rivers can be utilized to advantage, and if so, what portion of the cost of any such improvements, including reservoirs, should be borne by owners of water power and others.

2. Projects now in force provide for securing a 4-foot navigation on the Coosa River from Rome, Ga., to Lock 4, Ala., and for improving the Alabama River from its mouth to Montgomery by dredging and works of regulation. No work has ever been done on the Etowah River, and in recent years no work has been done on the Tallapoosa River. The plan of improvement now proposed by the district officer is for locks and dams on the Coosa, for storage reservoirs at the headwaters of the Coosa and the Tallapoosa, and for regulation on the Alabama. He recommends for the present the adoption of the plan set forth in Table "E" of his report (p. 50), which plan provides for 14 dams on the Coosa between Gadsden and Wetumpka and for the Etowah reservoir. Under this plan it is expected to secure a navigable depth of 4 feet on the Coosa from Rome to Gadsden, 6 feet from Gadsden to the Tallapoosa, and 6 feet in the Alabama from the Tallapoosa to the mouth of the river. The expenditure required on the part of the United States is estimated at $15,003,000 and the combined power and navigation improvement at $24,537,000. The district officer expresses the opinion that the locality is worthy of improvement by the United States in cooperation with power interests to the extent above indicated under certain conditions respecting the establishment of terminal facilities at important points. The division engineer concurs in general with the views of the district officer.

3. Subsequent to the above report efforts were made by the district officer to secure from interested power companies a definite offer of cooperation. In his letter of January 9, 1913, forwarding a communication dated January 3, 1913, he states that there is no present prospect of securing such cooperation.

4. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its accompanying report of July 30, 1913. While recognizing the advantages of navigation on these streams and the value of water power in connection therewith in the development of commerce and the advisability of coordinating these interests when practicable at

reasonable cost, the board does not believe that the probable benefits to general commerce and navigation would be sufficient to justify the expenditure of $15,000,000 on the part of the United States, even if private parties should undertake the power development on the terms proposed by the district officer. Neither does the board believe that the rental income from a combined development costing $24,537,000 would so reduce the cost to the United States of the improvement for navigation as to render the undertaking advisable at the present time.

5. After due consideration of the above-mentioned reports, I concur in general with the views of the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report that the improvement by the United States of Etowah, Coosa, and Tallapoosa Rivers, in the manner described in the reports herewith, is not deemed advisable at the present time.

Wm. T. Rossell,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Second indorsement.]

The Board of Engineers for Rivers and Harbors,
July 30, 1913.

To the Chief of Engineers, United States Army:

1. The board has given consideration to the report of the district officer on a survey of the Etowah, Coosa, Tallapoosa, and Alabama Rivers, made in compliance with the act of March 3, 1909, and has the honor to submit its views thereon. The item of law calling for this investigation has in view the improvement of the navigation of said rivers and a determination of whether storage reservoirs at the headwaters can be utilized to advantage; and if so, what portion of the cost of improvement, including reservoirs, should be borne by owners of waterpowers and others.

2. Surveys were made of one reservoir site on the Etowah, one on the Conasauga, and two on the Tallapoosa River; also of various lock and dam sites on the Coosa River. The Etowah and Oostanaula Rivers form the Coosa and the Coosa and the Tallapoosa Rivers form the Alabama. The Coosa is now navigable from Rome, Ga., to Lock No. 4, Ala., 182 miles. From Lock No. 4 to Wetumpka, 116 miles, it is not navigable; from Wetumpka to the Gulf, 323 miles, the Coosa 11 miles, and the Alabama, 312 miles, are navigable. The project depth for the Coosa, Rome to Lock No. 4, is 4 feet, and the same for the Alabama. The Etowah and the Tallapoosa are not under improvement.

3. The plan of improvement proposed by the district officer for locks and dams on the Coosa, for storage reservoirs on the headwaters of the Coosa and the Tallapoosa, and for regulation on the Alabama. Under the head of reservoirs the district officer presents data bearing upon available storage, reservoir capacity and cost, effective storage, effect on navigation and effect on waterpower. He proposes a site for a reservoir on the Etowah River at a point about 3 miles east of Cartersville, Ga. It is estimated that the

average yearly run-off amounts to 69,000,000,000 cubic feet. The reservoir capacity, with a dam 174 feet high, is given as 42,000,000,000 cubic feet, or about 60 per cent of the mean annual supply. The estimated cost of the reservoir is $4,000,000, including cost of dam construction and all incidental cost of flowage. The effective storage, or the amount that will actually be available for power and navigation in excess of the natural low-water flow, is 37.7 billion cubic feet. With regard to the effect on navigation, the district officer estimates that on the upper Coosa a low-water flow of 800 second-feet would, with 30,000,000,000 cubic feet effective storage, be increased to 3,600 second-feet, which with regulation would, in connection with the lock and dam at Horse Leg Shoal, already provided for, give 4 to 6 foot navigation between Rome and Lock No. 1, depending upon the amount of channel improvement. On the Alabama at Montgomery, a low-water flow of about 2,100 second-feet, supplemented by an effective storage of 36.8 billion feet, would become 6,600 second-feet, and a flow of 3,300 second-feet at Selma would be increased to 7,700 second-feet. This should raise the Montgomery gauge height from −1.9 to +0.8, a difference of 2.7 feet. The present project for the Alabama is for a 4-foot navigable depth at zero of gauge. Without increased flow this depth can be secured only by very extensive regulation, while with 6,600 second-feet the district officer estimates that 4 feet could be secured with moderate regulation and 4.8 feet with the work contemplated under the existing project estimated to cost $500,000. The effect on waterpower is discussed at some length by the district officer. He selects for the purpose of estimate 6 sites on the Coosa where it is believed power can be profitably developed at this time. At these sites he estimated the 1904 low-water flow at from 1,063 second-feet to 1,432 second-feet. It is expected that the effect of storage from the several dams and from the Etowah Reservoir will increase the flow to amounts varying from 3,970 second-feet to 5,120 second-feet. The head at the several dams is given at from 26 feet to 63 feet, which the district officer estimates will, with the local and Etowah storage, result in a total of 222,185 10-hour horsepower delivered. The increase in primary power on account of Etowah storage is given as 98,354 secondary horsepower made primary, and an additional primary power of 25,477, or a total of 123,831 horsepower.

4. The district officer presents data for a reservoir on the Conasauga River similar to those given for the Etowah Reservoir, but on account of the lack of definite gaging information the estimates are approximate only, and no work is recommended at this place for the present.

5. Data covering two reservoirs on the Tallapoosa are given in detail, including estimates of cost and plan of cooperation by the United States and water-power interests. As one of these reservoirs would be capable of storing the available supply of water, the district officer recommends that consideration be given to that one only, and in view of the fact that no definite plan of cooperation has been entered into between the United States and the power interests owning this site the district officer does not recommend any expenditures on the part of the United States at this time.

6. He recommends for the present the adoption of the plan set forth in Table E of his report, which plan provides for 14 dams on

the Coosa between Gadsden and Wetumpka and for the Etowah Reservoir. The amount of expenditure required on the part of the United States is as follows:

For 8 low dams and all locks on the Coosa River, 10 single locks and 4 flights of 2 locks	$6, 990, 000
For navigation share of 6 high dams	4, 013, 000
For Etowah reservoir	4, 000, 000
Total	15, 003, 000

Total estimate for combined power and navigation improvement is $24,537,000.

The estimate for maintenance and operation is as follows:

Etowah Reservoir	$10, 000
Regulation maintenance, upper river	20, 000
10 single locks and dams, at $5,000	50, 000
4 flights of 2 locks, at $6,000	24, 000
Regulation maintenance, Alabama River	100, 000
Total annual maintenance	204, 000

It is expected under this plan to secure a navigable depth of 4 feet in the Coosa from Rome to Gadsden, 6 feet from Gadsden to the Tallapoosa, and 6 feet in the Alabama from the Tallapoosa to the mouth of the river. The district officer expresses the opinion that the locality is worthy of improvement to the extent above recommended, and, further, that the money appropriated should be made available only when public wharves, warehouses, and freight-handling facilities and steam and electric railway connections therewith, as may be approved by the Secretary of War, shall have been constructed, or bond equal to their estimated cost shall have been given for such construction, at Selma, Wetumpka, Riverside, Ragland, Gadsden, Ala., and Rome, Ga. He further states that reservoir sites of this type are rare, and that the construction of this reservoir is a part of the most advantageous plan for the development of this river system, and he recommends that in the interests of economy, without reference to the time of construction, provision be made for the acquisition of this site as soon as possible. Subject to certain comments as to determination of water-rental values, the division engineer concurs in the views of the district officer.

7. With regard to the rental to be paid by water-power interests, the district officer states that the rental to be specified in the contract on the power developed from the natural flow of the river should finally be equivalent to interest at commercial rates on the expenditure saved by power companies due to the Government expenditure on the dams in the Coosa River. Rental should for a reasonable time be based on power sold, as only such power has an actual value. If the Government expenditure at each dam is the amount given in Table E, Column IV, as chargeable to navigation, and 6 per cent is assumed as proper commercial interest, the final rental per year of horsepower for primary power obtained (as given in Table C, Column I) would be as follows:

Lock No. 2, $1.60; Lock No. 6, $3.05; Lock No. 10, $2.72; Lock No. 11, $2.47; Lock No. 12, $2; Lock No. 13, $2.50. A rental of $1 per year for the first five years, and between $1 and the final rental for the next five years is considered equitable. For the increased power due to the Etowah Reservoir, he recommends that each company at a power dam on the lower river be granted the right to utilize the power due to the increased flow created by the reservoir and pay therefor a charge on the basis of $1 per year for the first five years, $2 per year for the next five years, $3 per year for the following 10 years on all 10-hour horsepower sold in excess of the amount due to the minimum natural flow of the river, the actual amount of this excess power to be determined by the Secretary of War, and that after 20 years the charge be $3 on all excess power obtainable.

8. The commerce of the Alabama River for 1909 as given in the Report of the Chief of Engineers for fiscal year ending June 30, 1910, was 85,350 tons, valued at $6,043,140, the most important items being cotton 11,061 tons, value $2,654,700; merchandise 13,994 tons, value $1,609,778; fertilizer 16,946 tons, value $398,231; naval stores 3,509 tons, value $248,000. The commerce given for the Coosa River for the same year is 119,072 tons, valued at $827,204, the principal items of which are sand 55,000 tons, value $50,000; logs 58,000 tons, value $38,600; cotton 1,056 tons, value $253,440. It is estimated that with an improved river the amount of commerce would be greatly increased, as the country tributary is rapidly developing and there is a large potential commerce in iron ore, coal, marble, clay products, cement, and other commodities not yet fully developed.

9. At the request of interested parties a hearing was given at the office of the board on October 26, 1911, which was attended by Capt. W. P. Lay; Hon. F. D. Kohn; Capt. J. M. Elliot; Hon. J. L. Burnett, M. C.; Hon. G. Lee, M. C.; and Hon. G. W. Taylor, M. C., all of whom addressed the board in favor of the improvement of the river.

10. The question of water-power development for commercial purposes by private capital alone or in cooperation with the General Government in the interests of navigation is one of growing importance, and it may be that when the proper time arrives some satisfactory arrangement can be made by which the greater part of the cost of the improvement under consideration will be borne by private interests, while the Federal Government retains general control of the stream and the power developed upon it. As indicated by the accompanying letter from the district officer, dated January 9, 1913, and the letter from the Alabama Power Co., dated January 3, 1913, there is no present prospect of such cooperation. Under existing conditions, therefore, it is considered premature for the Government to take steps looking toward power development on these rivers, as outlined by the district officer.

11. While recognizing the advantages of navigation on these streams and the value of water power in connection therewith in the development of commerce, and the advisability of coordinating these interests when practicable at reasonable cost, the board does not believe that the probable benefits to general commerce and navigation likely to result from the improvement under consideration would be sufficient to justify the expenditure of $15,000,000 on the part of the United States, even if private parties should undertake the power-development portion of the project on the terms proposed by the district officer. Neither does the board believe that the rental income from a combined development costing $24,537,000 would so reduce the cost to the United States of the improvement for navigation as to render the undertaking advisable at the present time.

12. With reference to the subject of terminal and transfer facilities it appears from Table F of the report of the district officer that the several important localities to be affected by the improvement are prepared to construct wharves and suitable terminal facilities. The subject of water power is fully treated by the district officer, and he states in reference to floods that the effect of the Etowah reservoirs would probably reduce the floods at Rome by about 50 per cent and the Tallapoosa Reservoir should reduce the floods at Montgomery about 12 per cent. In compliance with law, the board reports that none of these questions are so related to the proposed work as to render it advisable at this time in the interests of navigation.

For the board:

W. M. Black,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF ETOWAH, COOSA, TALLAPOOSA, AND ALABAMA RIVERS, GA. AND ALA.

War Department,
United States Engineer Office,
Montgomery, Ala., June 1, 1909.

Sir: 1. I have the honor to submit the following report on preliminary examination of the Etowah, Coosa, and Tallapoosa Rivers:

2. The river and harbor act, approved March 3, 1909, provides for examination of—

> Etowah, Coosa, and Tallapoosa Rivers, with a view to their improvement for navigation. Such examination for the improvement of the navigation of said rivers, including the Alabama River in connection therewith, shall include investigations necessary to determine whether storage reservoirs at the headwaters of said rivers can be utilized to advantage, and, if so, what portion of the cost of any such improvements, including reservoirs, should be borne by owners of water power and others.

3. The approved projects under which work is now being done provide for securing 4-foot navigation on the Coosa River from Rome, Ga., to Lock 4, Ala., and for improving the Alabama River from its mouth to Montgomery by dredging and works of regulation, which improvement it is hoped will give 6-foot navigation for nine months during the year. Reference is made to Annual Report of the Chief of Engineers for 1908, pages 387–391, for summary of previous projects and improvements.

No work has ever been done on the Etowah River; a survey was made of this river in 1879, report being unfavorable because of lack of population and of development of mineral resources.

During recent years no work has been done on the Tallapoosa River; work that was at one time done consisted in snagging operations near the mouth of the river.

A comprehensive report on the improvement of the Alabama and Coosa Rivers was submitted by Capt. (now Maj.) Cavanaugh on June 30, 1904. This report is printed in House Document No. 219, Fifty-eighth Congress, third session, and in Annual Report of the Chief of Engineers for 1905, page 1351, et. seq. Reference is made to this report for general description of the Alabama River, project for improvement of both rivers, discussion of freight rates, and cost of water haul from the Coosa Valley to Mobile, information concerning the resources of the valley at that date, and prospective commerce with the rivers improved.

4. The present river and harbor act requires consideration of storage reservoirs, coordination of water power and navigation, and the revision of commercial data.

STORAGE RESERVOIRS.

5. The question of storage reservoirs will be discussed under the heads of—

(*a*) Benefits to navigation;
(*b*) Benefits to water power; and
(*c*) Reservoir sites.

(*a*) *Benefits to navigation.*—The length of the river to be affected by storage is 526 miles, being the Coosa from Rome, Ga., to Lock 1, from Wetumpka, Ala., to the mouth of the Tallapoosa River, and the Alabama River. The affected section of the upper Coosa would be shortened by a lock at Horseleg Shoals and a high dam at Lock 2. Only the lower Coosa and the Alabama will be considered in detail.

The following discussion is based on an assumed discharge of 6,000 second-feet at Montgomery:

The Alabama River has comparatively stable banks. It has no lower tributary which has a low-water flowage of importance. The lowest low-water discharge at Selma (1904) was 3,300 second-feet, and at Montgomery 2,150 second-feet. The relative effects of storage will decrease as you go downstream. The present relative needs of navigation also decrease downstream.

The effect of a certain discharge on the river gauges is as follows:

Gauge.	Discharge—		Gauge.	Discharge—	
	At Montgomery.	At Selma.		At Montgomery.	At Selma.
Feet.	*Second-feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Second-feet.*
−1.9	....	3,150	0.2	4,650	6,440
−1.8	2,150	3,300	.4	5,000	6,780
−1.6	2,275	3,600	.6	5,375	7,120
−1.4	2,450	3,900	.8	5,775	7,460
−1.2	2,625	4,200	1.0	6,225	7,800
−1.0	2,850	4,500	1.2	6,650	8,160
− .8	3,100	4,820	1.4	7,100	8,520
− .6	3,400	5,140	1.6	7,550	8,880
− .4	3,700	5,460	1.8	8,050	9,240
− .2	4,000	5,780	2.0	8,550	9,660
.0	4,325	6,100			

These gauges are in pools below the middle of the pools. From observations made last year it was found that an increased flowage gave practically the same increase of depth on bars and at these gauges as seen in Table 2. This conclusion corresponds to the practice of the pilots, who figure that a foot more on a gauge (in a pool) gives a foot more on the bars. These gauges were placed so that zero on the gauges gave 3 feet on the bars. This relation was verified last fall while trying to bring to Montgomery a dredge drawing 3 feet 2 inches while the river fluctuated a few tenths from the Montgomery gauge zero.

From the above it is seen that 6,000 second-feet minimum flowage will increase the navigable depth 2.8 feet (from -1.8 to $+1$) above low water of 1904, and will give 4.8 feet over bars, or 4-foot navigation, without further regulation. With regulation, this depth can be increased. The theoretical possibilities with regulation, computed by Mr. D. M. Andrews, assistant engineer, using constants closely approximated for this river, are given in Table 2. The approach to these possibilities is limited only by excessive cost of regulation. With 6,000 second-feet low flowage it is considered practicable to obtain 6-foot navigation all the year with reasonable expenditures; that is, with such regulation as will give 6-foot navigation for nine months under present conditions. In 1904 the flowage was less than 6,000 second-feet for more than three months. The maximum feasible regulation will give 8-foot navigation.

The next question is: How much water is required to maintain a minimum of 6,000 second-feet at Montgomery? The gauge readings here are complete from 1890 to date. The lowest and longest duration of low water of record was 1904, the year 1903 being one of fairly high water. The next worst year was 1897, the previous year being also low. Therefore, 1904 and 1897 are taken as the critical years during a period of 19 years of gauge record. Incidential office records back to 1876 mention no such extreme low-water periods. However, semiofficial records of the Alabama Historical Department mention 1840 as an extreme low-water year, when navigation stopped on the Alabama River (about 1-foot draft) and fish died in the Warrior River. The year 1839 was also an extremely dry year.

Below is given the computed flowage at Etowah Reservoir site and shortage at Montgomery for these critical periods. The available flowage was obtained by deducting the total low-water flowage and an assumed flowage of 600 second-feet (exact amount to be fixed later) for high-water months, and its relation to shortage below 6,000 second-feet at Montgomery is as follows, in billion cubic feet:

	1895	1896	1897	1903	1904
Available flowage of Etowah River at reservoir site	48	24	30	70	9
Shortage of Alabama River at Montgomery below 6,000 second-feet	6	18	25	5	32

Allowing 60 inches per year for evaporation on reservoir, the available storage will be sufficient to maintain 6,000 second-feet at Montgomery with a margin of about 50 per cent for losses, due to unavoidable errors of control and for losses en route. Further investigation is necessary to determine these losses en route. It may be found practicable to lessen errors of control by a 12-hour pondage at lower dam on Coosa River.

Drawing 2, obtained from drawing 1, shows the amount (in billion cubic feet) of storage required to maintain the gauge at various heights. The abrupt curve, due in part to water being raised above narrow channel, shows the necessity of combining regulation with storage. For example, the second 10,000,000,000 cubic feet of storage without regulation will raise the gauge reading but 0.3 in 1904 or 1897. Its effect with regulation is seen in Table 3.

(*b*) *Benefits to water power.*—The great value of the water powers on the Coosa River has been long recognized. The original project, devised before development of hydroelectricity, was later disapproved by Maj. Judson because it destroyed the water power. Maj. Cavanaugh's later project provides for higher dams, which will develop a large per cent of the horsepower.

The main conflict between navigation and water-power interests would seem to be due to the fact that the proposed development for water power and the proposed improvement for navigation were not coincident as to time. Recently extensive investigations of Coosa River water powers have been made by various private interests. While, prior to complete survey and estimates, the proper ratio of cost and benefit can not be thoroughly discussed, a few outlines will be given as bearing upon the feasibility of possible cooperation. There can be developed on this river, with its natural flow, about 40,000 (24 hours per day) horsepower. The benefits to water power from a storage reservoir will be in practically the direct ratio of the present low-water flow (about 1,500 second-feet) to the attained flow. Assuming this attained low-water flow at 6,000 second-feet at Montgomery, the value of the horsepower on the river will be multiplied by more than three, and, again, depending on the use to which these powers are to be put (car lines or factories), they can be doubled in whole or in part by providing, at a low-navigation dam, a 12-hour pondage below the last power dam or at some of the intermediate low dams. The value of these water powers is so great that if the entire rivers were turned over to private interests the reservoir dam and power dams would no doubt be speedily constructed. This, however, would mean that one interest must control the whole river, which contingency is objectionable, and it seems that in general the line of cooperation should be that, owing to the large benefits to navigation, the General Government should own and control the storage reservoir dam and the lower regulating dam, which dams should be operated as navigation alone may require. The incidental benefits and disadvantages should receive prior monetary consideration.

In addition to the water powers on the Coosa River, the water powers on the Etowah River will also become valuable. The slope of the river just above the reservoir dam is very great, therefore the lower 40 feet or more of the dam will provide no great amount of storage and can be used for power. This power, and also the power that can be developed on the Etowah River, will be great in summer and small in winter; that is, the almost exact complement of the water-power development on the Chattahoochee River, which development is within a radius of 40 miles, and could thus be benefited by storage, as can the Coosa River powers. The improvement of this river, in cooperation with water-power owners, is feasible, and will materially reduce the cost to be borne by the United States.

(*c*) *Reservoir sites.*—Examination has been made on the Etowah and Tallapoosa Rivers, also on the Conasauga and Coosawattee Rivers, which rivers form the Oostanaula, which unites with the Etowah at Rome, forming the Coosa. Three sites considered worthy of further investigation were found. The Coosawattee River site above Carters, owing to steep slope of river above dam and high dam required, will not be further considered, but is included in table below.

Below is given the characteristics of various sites. This table was prepared by Mr. D. M. Andrews, assistant engineer, with such data as are at hand, but so far as regards capacity of reservoir and flooded land, the estimates must be considered approximate only, though it is believed they are fairly conservative.

RESERVOIRS.

Estimated flowage.

No.	River.	Site.	Drainage area.	Flowage (billion cubic feet).				
				1895	1896	1897	1903	1904
			Sq. miles.					
1	Conasauga	Below Jack River	85	6.0	4.1	5.0	8.5	4.0
2	Coosawattee	Above Carters, Ga	441	35.0	23.9	29.1	41.8	17.9
3	Etowah	Cartersville, Ga	1,023	72.0	49.1	67.8	92.5	33.5
4	Tallapoosa	Below Little Tallapoosa	1,436	63.3	61.6	65.1	153.0	60.0

Estimated capacities.

River.	Dam site.	Height of dam.	Area.	Capacity.
		Feet.	*Square miles.*	*Billion cubic feet.*
Conasauga	Below Jack River	50	2.5	3.48
		100	5.0	8.71
Coosawattee	Above Carters, Ga	100	2.1	3.25
		150	4.0	9.20
		175	6.0	16.10
Etowah	Cartersville, Ga	160	30.0	28.00
		180	38.0	63.00
		200	85.6	90.00
Tallapoosa	Below Little Tallapoosa	100	38.0	52.94
		150	76.0	132.35

Etowah River.—On the Etowah River, just below the mouth of Allatoona Creek, about 3 miles east of Cartersville, Ga., is a proposed reservoir site. The river here is about 300 feet wide. The bottom and banks are granite. One bank rises about 1 on 1, the other 1 on 2. The hill on either bank is several hundred feet high, there being beyond each hill a saddle depression (estimated elevation 160 and 195, respectively). One of these could be made to serve as a spillway. This dam site was inspected by Mr. D. M. Andrews, assistant engineer, and myself, and is all that could be desired for a dam of any height up to 200 feet. The land that would be submerged does not seem to be especially valuable. A considerable portion of the land near the dam site is now lying out, reported as being part of an old estate, long encumbered and neglected. It is estimated that of the land flooded by a 200-foot dam at this place about three-fourths of it is either wooded or in a very low state of cultivation. The remaining one-fourth contains some valuable farming land. It was feared that a dam at this place might flood valuable mining property, but from the reports of the United States

Geological Survey and the Georgia Geological Survey it will be noticed that what is known as the Cartersville fault (map No. 2)[1], dividing the Paleozoic from the Crystalline era, cuts off some 10 counties of northwest Georgia and passes just west of Pine Mountain and below this dam site. This circumstance is considered particularly fortunate, leaving, as it does, the iron, manganese, ocher, and bauxite tributary to the river and providing the best possible foundation for a dam. The flooding of valuable farming lands is considered the only serious objection to a reservoir at this site, but it would be difficult at this date to find a site where apparently so little valuable land would be flooded. The question becomes one of cost, against which must be weighed resulting benefits. The computed run-off at this dam site is given above. From the information at hand—that is, United States Engineer profile of river to Little River, maps of the Geological Survey, and rough profiles and cross sections taken in the basin with barometer and hand level—it is estimated that a dam between 150 and 190 feet high will impound a large percentage of the available storage at this place. A survey of this site should include investigations as to silt, available flowage, flooded lands, and cost; also loss from reservoir to navigable river.

Conasauga.—A reservoir site near the head of the Conasauga River was found. This site, as may be seen from photographs,[1] is practically ideal so far as dam and pond area are concerned. The flowage at this site has been estimated, and though it is not great, being only eight and one-half billion cubic feet for the year 1903, it is believed that for the storing of this amount of water this site may prove as economical as any other. The effect that this amount of water would have is seen on drawings 2 and 3; that is, it would maintain the flowage at Montgomery at about 4,000 cubic feet per second. It would add to the discharge of the Oostenaula River, which item is worthy of consideration. It also adds to the value of powers on the Coosa River, and would more than double them. This site will need special investigation as to silting, as well as to the flowage.

Tallapoosa.—On the Tallapoosa River many places were found where high dams could be constructed, a most favorable place being below the mouth of the Little Tallapoosa. The estimated flowage and capacity of the dam is given in tables above. This is considered a very good site for a reservoir dam, but the increased flowage due to such a dam will not add to the water powers on the Coosa. The expense without contribution from the water-power interests will make the cost excessive. There are now developed and in operation two dams on the Tallapoosa River below this site. The favorable conditions at this dam site warrant a survey sufficient to show the physical possibilities, to allow the preparation of a plan of cooperation, and to allow the purchase of the necessary lands before towns and railroads are located on same. It is to be noted, in this respect, that only valuable farming lands or mines flooded can be considered as actual loss, as the position of country towns and railroads is more or less accidental, their initial location being optional within a radius of several miles. A storage dam on this river will increase the flowage of the Tallapoosa River, which, no doubt, in course of time will be worthy of improvement.

[1] Not printed.

SILTING.

6. The probable silting up of reservoirs has been considered. Aside from silting due to local erosion, which is easily preventable, the silting up of a reservoir will, in my opinion, depend largely on where it is located with reference to the river profile. In the mountains it has been observed that dams readily fill up; at one point, 6 miles from the mountain top, in virgin forest, it was noticed that a few logs thrown across a small stream valley had in a few floods accumulated silt to make a level lumber yard of several acres. Dam No. 2, on the Coosa River, was built in 1881 and has not silted up appreciably. This would seem to be explainable on general principles. Generally speaking, the erosion in the mountains is very great; the carrying capacity of streams is very great until a decided change of slope is reached, the carrying capacity varying at the sixth power of the velocity. "The stream bed is constantly trying to adjust itself to its base level, where there is neither cutting nor filling;" therefore a dam built within the zone of this adjusting slope will silt up more rapidly than a dam built farther away from the base of the mountain or this decided change of slope in the stream. Of the dam sites that have been examined, the Etowah and Tallapoosa sites are well away from this decided change of slope. On these rivers no danger from silting is anticipated. All dam sites would require very careful investigation in this respect.

Aside from this silt that is transported along the bottom of a stream, a large reservoir will form a settling basin, and perhaps a great part of all the continuous sediment would be deposited. During the last eight months attempts have been made to measure the silt in the Coosa River below Gadsden, and, though the river is in appearance very muddy, the sediment was found to be negligible. Mr. Andrews's report gives details.

PRESENT AND PROSPECTIVE COMMERCE.

7. The commerce reported on the Coosa River between Rome, Ga., and Gadsden, Ala., for the year ending December 31, 1908, was $3,544,500. This length of river is 134 miles. It has two railroads on one side and one railroad on the other. During periods of extreme low water profitable navigation is impossible above Horseleg Shoals, for which place a lock and dam has recently been recommended.

During the year 1908 the commerce on the Alabama River was about $9,000,000. During several past years the boat lines on this river ran only to Selma until last winter, since which time two boats each week have been running regularly to Montgomery with loads of from 150 to 200 tons. Grain from the West, coffee and sugar from New Orleans, dry goods from New York, and cotton downstream have been the chief items of commerce.

The main changes in the commercial statistics of this section since Capt. (now Maj.) Cavanaugh's report in 1904 are:

First. Increase of about 38 per cent in value of taxable property.
Second. Large increase in all manufacturing plants and their products.
Third. More accurate and greatly increased estimates of total workable iron ore and coal.
Fourth. Large increase in iron mined; also in lime and limestone output.
Fifth. Initial development of marble industry.
Sixth. Initial development of cement industry in Ragland district.

Statistics have been collected from 15 counties tributary to the Coosa River in Alabama and Georgia, and the following is a summary of these statistics:

Summary of statistical data of the Coosa River valley, 15 counties, Alabama and Georgia.

Population (1908)		380,000
Increase in total tax valuation from 1904–1908 (five years)	per cent	38
Capital invested in manufacturing plants		$35,937,000
Products of manufacturing plants (1908):		
Quantity	tons	1,280,000
Amount		$47,865,000
Capital invested in iron ore furnaces		$9,354,000
Products of iron ore furnaces (normal):		
Quantity	tons	900,000
Amount		$13,500,000
Capital invested in cotton mills (1908)		$13,813,000
Products of cotton mills:		
Quantity	tons	51,380
Amount		$20,014,000
Cotton used in cotton mills	bales	224,200
Cotton raised in 1907	do	178,500
Value of grain crop (1907)		$8,625,000
Iron ore mined (normal)	tons	1,750,000
Other ore mined (normal)	do	50,000
Limestone and lime (normal)	do	700,000
Marble quarried (1908)	cubic feet	100,000
Coal mined (normal)	tons	520,000
Value of mineral products (normal)		$5,000,000
Coal consumed (1908)	tons	550,000
Coke consumed (1908)	do	740,000
Timber cut (1908)		$1,976,000
Cement made (per year)	barrels	440,000
Bricks (fire, paving, and ordinary), yearly capacity of plants	tons	200,000
Fertilizer manufactured	do	55,600

The above statistics were carefully collected. It is considered conservative to estimate that the present commerce to and from points in the valley exceeds $50,000,000 per year.

While finished products do not seek the cheapest routes of transporation with the same persistence as do raw materials, it is believed that owing to the character of the products of this valley, being heavier products, a fair percentage will be carried on the river.

The prospects of commerce on the Coosa-Alabama Rivers are based on the natural resources of the Coosa River Valley, as well as on the present state of their development. These resources consist in iron and coal, marble, cement, limestone, and clay products, timber, cotton, and other agricultural products.

Iron and coal.—The total workable iron ore tributary to the Coosa is estimated at 300,000,000 tons, of which about 800,000 tons is used by furnaces and 1,750,000 tons is being mined annually. There is fluxing lime and coal near this iron ore. In short radius is found different classes of iron requisite for economic smelting. Attention is invited to the relative cost of assembling raw material for one ton of iron in England, at Pittsburgh, and at Gadsden.

The total workable coal tributary to the Coosa is estimated at 600,000,000 tons. While the chief use of this coal will be in the iron furnaces, cement works, and the preparation of clay products, there will remain some for export. A railroad has recently been constructed from the Blount Mountain fields to Gadsden.

Marble.—The marble deposit of Talladega County, Ala., outcrops near the Coosa River and extends for a distance of about 35 miles, being nowhere more than about 15 miles from the river. This deposit contains practically inexhaustible quantities of white marble comparable to the Italian. It also contains three times this amount of blue marble. Further information concerning this marble is given in Appendix "D," herewith.

Cement, limestone, and clay products.—The close proximity of practically unlimited cement materials, coal, and the Coosa River has been known for many years as a geological coincidence, and makes a natural location for cement industries. A cement plant of 600,000 barrels annual capacity is now being constructed at Ragland, Ala.

The unlimited limestone deposits are now being extensively worked in the vicinity of Gadsden, the annual output being some 700,000 tons. In addition to the use of this limestone for building purposes, a great deal of lime is now shipped to Louisiana for use in sugar factories and also as a fertilizer, and it is represented that with cheap river transportation the amount shipped for fertilizer would be very great, the saving in freight being enormous.

The immense beds of valuable clay, including kaolin, pottery clay, and fire-brick clay, paving and common brick clays, are near coal. River transportation will increase the present not inconsiderable output of this class of products by giving them a large radius of market at low rates.

Cotton.—In the Coosa River valley there was produced last year 178,000 bales of cotton. The cotton factories in this section used 224,200 bales. In the counties on the Alabama River, below counties above considered, there was raised 190,000 bales of cotton. Raw cotton is worth about half as much as the coarsest kind of cotton yarn. It is reported that the United States last year imported cotton goods the value of which was twice the value of all the cotton exported. Surely this "economic crime" can not long continue. The incidental development of water power in connection with navigation will, in many instances, of which this is one, tend to build up traffic on the river. All the cotton near the Alabama River can, at a cheap rate, go to the cotton mills on the upper Coosa River, or, in fact, on the Alabama River, within the hydroelectric radius of the Coosa. The river will give this cotton a low rate for export as raw cotton, and also a low rate to any cotton mill. It also gives the cotton mills a low rate for the coarser cotton goods to Mobile en route to China. All of Alabama's cotton manufactured into coarser yarn will mean an annual income of over $50,000,000. By manufacturing the higher grades of cotton cloth, the figures become fabulous.

Minor items.—For details as to bauxite, ocher, and manganese reference is made to Appendix B.

There is manufactured in this valley 56,600 tons of fertilizer, which is locally distributed. Phosphate rock, chiefly from Florida, forms the bulk of this fertilizer. Of the other ingredients nitrate of soda, pyrites, kainit, and potash nitrate come from Germany, Spain, and the west coast of South America and form about one-sixth of the total tonnage; therefore this item becomes about 9,000 tons now hauled from Gulf ports at a rate of $2.50 per ton. The saving in this item would be very great, and, depending somewhat upon the intracoastal waterway, it may be possible that it will be economical to bring phosphate from Florida by water.

The opening of the river and movement of marble works to the river will create a demand for sand for polishing purposes, the sand of s itable grade to be hauled by river from points along the river where it may be found.

Sugar and molasses from Louisiana and coffee from the South are now shipped to this valley. The shipments of these commodities will constantly increase.

In general.—The Coosa-Alabama River possesses none of the inherent disadvantages that mitigate river commerce. Its length is sufficient to allow a saving in haulage that will more than counterbalance the extra cost of transfer. It does not run transverse to the lines of present trade, but runs toward the market for the valley's products. The question is already being agitated of building a railroad from Anniston to Montgomery and of double-tracking the Louisville & Nashville Railroad to the Gulf. The railroads now cut by an east and west line through Birmingham exceed the railroads that run south to the Gulf. The commerce incident to the development of the incomparable resources of this section and the through traffic toward Panama will demand more lines of traffic toward the Gulf.

With the incidental development of water power the General Government can reserve a part of this power and donate it to the various cities and towns of the valley on condition that they use it for running electric cars to the river. Though this is a question of policy, the right is clearly given in the commerce clause of the Constitution.

Further details concerning the above-mentioned items are given in appendices herewith. Freight movement and freight rates are shown in Appendix H.

ETOWAH RIVER.

8. The report of 1879 by Lieut. (now Gen.) Marshall is unfavorable to the improvement of this river because of the sparse settlement of the community and the fact that the mineral resources were not then developed.

The fall of the Etowah River from Cartersville to Rome is about 119 feet. Its improvement would require locks and dams. The main argument for this improvement would be based on cheapness in the haul of iron from the Cartersville district to the coal near Ragland or Gadsden, or, vice versa, the hauling of coal to the iron district. The present rate on iron from Cartersville to Gadsden is 65 cents per ton and the rate on coal from Ragland to Cartersville $1.05 per ton. These rates can be materially reduced by river transportation. The iron now mined at Cartersville and Emerson amounts, according to the table herewith, to 248,000 tons per year. This iron is reported to be hauled to Gadsden, at least the greater part.

Owing to the fact that the water-power development along this river, if a reservoir dam is constructed, will be particularly valuable, as it is the complement of the power now developed on the Chattahoochee River, it is believed that in the course of a short time the water-power interests will take up the question of placing power dams on this river.

This river is considered worthy of improvement on condition that the water-power interests pay their proportion of the cost.

TALLAPOOSA RIVER.

9. Between 1884 and 1892 the Tallapoosa River was improved by regulation from the foot of Tallassee reefs to its mouth, a distance of 48 miles, at an expenditure of $84,125.

The low-water discharge of this river is very low, being about 300 second-feet in 1904. The river is very tortuous, and without locks and dams can not be made navigable, except up to the falls at Tallassee. This territory is naturally tributary to Montgomery. The rail haul is much shorter than the river haul. Until the Alabama River is improved to Wetumpka, there is no necessity for improvement. If a reservoir is built on the Tallapoosa, the lower river can perhaps be improved by regulation. It is therefore not considered worthy of improvement at the present time.

WHARFAGE AND TRANSFER FACILITIES.

10. There are at present no wharves other than earth roadways to the river, either on the Coosa or the Alabama. There is land physically available at all of the river towns and cities. Rome, Ga., owns no proper wharf frontage. Gadsden, Ala., owns 8 acres that can be used for wharf and warehouse only. Montgomery and Selma own sufficient wharf frontage. The city of Montgomery has recently issued bonds for $10,000 to construct wharf and warehouse. The railroad commission of Alabama informs me that "if the river is gotten into condition where there will be all-the-year navigation, it is assured that facilities will be added at the points above mentioned to take care of the traffic, and these places can be made ports of entry, and as soon as facilities are put in the commission has authority to order connections or sidetracks to these facilities, and traffic can be transported to railroad cars at a nominal cost."

The present company operating boats on the Alabama River seems to be starting out with business methods and sufficient capital to develop river trade. They have within the last few months developed a good trade on this river up to Montgomery, to which point they now run two boats a week, and they state that more boats and barges will be put on as the trade develops, and if various municipalities do not provide wharfage and warehouse facilities, the boat company will provide these. It is also stated that cotton-gin compresses will be constructed on the Alabama River. Such location of compresses is, in my opinion, essential and will definitely solve the question of actual commerce on this river. In my opinion, when these rivers are made navigable in fact, proper wharfage and transfer facilities will be provided.

Concerning the question of aid from the General Government, it is respectfully suggested that consideration be given to the fact that a certain part of the work necessary may require the use of floating pile driver and dredge, and it may be practicable to arrange for the General Government to furnish this expensive plant. The result would be a very great saving to the municipalities and would be no great expense to the General Government.

FLOODS.

11. The effect of storage reservoirs on floods will, from the preliminary investigations made, be inconsiderable. The exact effect can only be determined when the actual storage capacity of the dams is determined by survey.

RECOMMENDATIONS.

12. The Coosa and Alabama Rivers are considered worthy of improvement by the General Government alone, or on the basis of cooperation with the owners of water powers.

The Etowah River is considered worthy of improvement from Rome, Ga., to Cartersville, Ga. Owing to the fact that the improvement of this river will give benefits only to be fully realized after the improvement of the Coosa and Alabama Rivers, it is recommended that this part of the project be delayed until the other is completed, or until the water-power interests desire to cooperate in the building of the dams.

The Tallapoosa River is not considered worthy of improvement at this time.

In my opinion reservoirs at the headwaters of these rivers can be utilized to advantage. The portion of cost to be borne by water-power owners and others can not be stated prior to a survey and estimate.

Capt. Cavanaugh, in his report of 1904, recommended that $30,000 be allotted for survey of dam sites on the Coosa River proper, these surveys to be made whether or not the project was approved, so that a proper division of cost to be borne by water-power interests could be determined. Since his report, $20,000 has been allotted for surveys on this river, which surveys complete the river from Gadsden to Lock 2 and near proposed Locks 12, 13, 14, and 15. To make proper surveys of the rest of the river it is estimated will require $5,000.

Of the reservoir sites, the survey of the Etowah River site is considered the most important. If 50 per cent of the estimated storage can be obtained, it will make possible 6-foot navigation on the Alabama River. The estimated cost of this survey is $15,000.

The Conasauga site is considered next in importance. Surveys of this site and of Tallapoosa River site are recommended, these surveys to be only outline surveys to determine in sufficient detail flowage and flooded land in order that the plan of cooperation may be outlined, and, if approved in general, the lands can be purchased, with a view to building the dams later. The estimated cost of these surveys is $5,000.

It is therefore recommended that $25,000 be allotted for the surveys necessary on the Coosa River and of reservoir sites on the headwaters of the Coosa and Tallapoosa Rivers in order to consider what portion of cost should be borne by owners of water power and others.

Very respectfully,

H. B. Ferguson,
Captain, Corps of Engineers.

The Chief of Engineers, United States Army
(Through the Division Engineer).

[First indorsement.]

OFFICE DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., June 19, 1909.

Respectfully forwarded to the Chief of Engineers, United States Army, concurring in the opinion of the district engineer, that the prospective commerce to be developed and the benefits which will be produced by the contemplated improvement appear to be sufficient to warrant the expenditure of funds required to make the necessary survey in order to obtain full information upon the subject.

LANSING H. BEACH,
Lieut. Col., Corps of Engineers,
Division Engineer.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., July 6, 1909.

1. Respectfully returned to the Chief of Engineers, United States Army.

2. The item of law calling for this examination requires consideration of questions involving navigation, reservoirs, water power, and the portion of the cost of any such improvements, including reservoirs, which should be borne by owners of water power and others.

3. These questions are so involved that it is impracticable to answer them without more detailed and extended information than can be secured by a preliminary examination. The board therefore concurs in recommending that the survey proposed by the district officer and the division engineer be authorized, and that in his further report he discuss fully the possibilities of coordinating water power interests with those of navigation, as required specifically by the item of law calling for this examination, and generally by section 13 of the act of March 3, 1909.

For the board:

D. W. LOCKWOOD,
Colonel, Corps of Engineers,
Senior Member of the Board.

[Fourth indorsement.]

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, July 14, 1909.

1. Respectfully submitted to the Secretary of War.

2. This is a report on preliminary examination of Etowah, Coosa, and Tallapoosa Rivers, Ga. and Ala., authorized by the river and harbor act of March 3, 1909.

3. Inviting attention to the report of the Board of Engineers for Rivers and Harbors in the preceding indorsement, I recommend that a survey of the locality as proposed be authorized.

FREDERIC V. ABBOT,
Acting Chief of Engineers.

[Fifth indorsement.]

WAR DEPARTMENT, *July 15, 1909.*

Approved.

ROBERT SHAW OLIVER,
Assistant Secretary of War.

Appendix A.

Report of Assistant Engineer D. M. Andrews.

Montgomery, Ala., *May 18, 1909.*

Captain: I have the honor to submit, in what follows, a preliminary report upon the engineering features of a comprehensive improvement of the Coosa River, in which the coordination of storage, navigation, power, and wharfage and transfer facilities are considered, together with a discussion of the effect upon the navigation of the Alabama River of storage reservoirs located near the headwaters of its tributaries.

The report is divided into the following heads, namely: Reservoirs, Navigation, Power, Wharfage and Transfers.

RESERVOIRS.

Reservoir sites have been investigated on the Etowah, Conasauga, Coosawattee, and Tallapoosa Rivers.

A very promising site was found on the Etowah, as were several on the Tallapoosa, and an ideal site on the Conasauga near the Georgia-Tennessee State line. No suitable sites were found on the Coosawattee below Carters, at which place the river emerges from the mountains of northern Georgia. Many fine sites were, however, found above that point. No gaugings have been made of the Etowah River near Cartersville, Ga., at the site of the proposed reservoir, and Table No. 1 was prepared from the gaugings at Canton, Ga., by multiplying them by 1.7, this ratio being obtained by interpolation between the gaugings at Canton and Rome, Ga.

In very wet years the percentage of the rainfall that reaches the river is large, while in dry years the percentage is small. In 1902, a wet year, the loss was only 13 per cent, and in 1904, the dryest year yet recorded, the loss was 81 per cent. Comparing this with Tables Nos. 2 and 3, it will be seen that the loss here was greater than at any other proposed reservoir sites.

The slopes of the Etowah watershed above Cartersville, Ga., are comparatively gentle and covered with a heavy forest, growing upon a soil overlying the "country rock" deeply in most places. This heavy forest and soil cover absorbed and retained 81 per cent of the light rainfall of 1904. Much of this loss could probably be prevented by clearing away the forest cover from the watershed.

An approximate cross section of the site proposed for the reservoir dam on the Etowah River is shown on photograph No. 1.[1] An inspection of the photographs [1] of the proposed dam site shows absolutely perfect rock abutments from the water surface to and above the 200-foot contour on each bank. There is every reason to believe that perfect rock foundation will be found in the river itself.

The Western & Atlantic Railroad near Allatoona, Ga., lies 10 to 20 feet below the 200-foot contour for a distance of some 2 miles. If a dam 200 feet high is built, this section of the railroad will have to be raised or relocated on higher ground, and a levee will have to be thrown across the divide at the head of Allatoona Creek to prevent flowage over the divide.

Mr. C. F. O'Keefe, inspector, who made the photographs referred to above, estimates the more valuable lands at about one-fourth of the proposed flooded area.

In drawing No. 1 there is shown for the low-water years 1895, 1896, 1897, and 1904, and for the high-water year 1903, the relation of the flow of the Etowah River at Cartersville to the shortage of flow at Montgomery for given gauge heights.

The flow of the Etowah, allowing for evaporation and summer flow, is more than sufficient to maintain a constant flow of 8,000 cubic feet per second, or a gauge height of 1.8 feet at Montgomery during the low-water period of the dry years 1895, 1896, 1897, and 1904.

From the best data available, the annual evaporation in the vicinity of the proposed reservoirs appears to be about 60 inches.

When the flow of a stream, during even the driest years, is more than enough to fill a reservoir located upon it, evaporation need not be considered, but when the flowage of the wet years must be stored for use in the dry years, then evaporation enters as quite an important loss.

As to the loss between a reservoir and a point below, authorities differ within wide limits. It is probable, however, from incomplete observations made by this office, that there is no such loss, or it is negligibly small.

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[1] Not printed.

Mr. Truss reports, April 21, 1909, no suitable dam or reservoir sites below Carters on the Coosawattee River; that is, on the navigable portion of the river. Mr. C. F. O'Keefe, inspector, extended his investigations into the mountains above Carters, and found several dam sites, at some of which dams as high as 400 feet can be built.

The annual discharge of the Coosawattee River at Carters, Ga., from 1897 to 1907, inclusive, was, in round numbers, as follows:

	Cubic feet.		Cubic feet.
1897	29,000,000,000	1903	42,000,000,000
1898	29,500,000,000	1904	18,000,000,000
1899	33,750,000,000	1905	27,500,000,000
1900	34,200,000,000	1906	52,500,000,000
1901	56,000,000,000	1907	38,500,000,000
1902	35,000,000,000		

The percentage of rainfall in the very dry year of 1904 was only 60 per cent, the smallest loss shown in any of the tables. This small loss was probably due to the greater slopes, and barren, rocky character of the watershed, thereby causing the light precipitation to flow readily into the river before it was evaporated or absorbed by the scanty covering of soil.

Turning again to the list of annual discharges given above, it is seen that the total discharge for 1904 was 18,000,000,000 cubic feet.

With dams ranging in height from 200 to 400 feet, and dams of these heights can be built on this part of the Coosawattee River, the loss from evaporation is negligible, and the storage of 18,000,000,000 cubic feet will furnish, with all losses deducted, a discharge of some 2,000 cubic feet per second for 90 days at Montgomery.

Mr. Truss reports no practicable dam or reservoir sites on the Conasauga River between its junction with the Coosawattee and the mountains of northern Georgia; but Mr. O'Keefe found near the Georgia-Tennessee State line a most promising dam and reservoir site, just below the junction of the Conasauga and Jack Rivers. The site illustrated in the photograph[1] is ideal; the element of doubt as to its availability is the flow of the Conasauga at the proposed dam site. Is the annual discharge sufficient to fill the reservoir in the driest years? This question can be definitely answered only after a series of discharge measurements have been made at or near the site of the proposed dam covering a period of one or more years. Nevertheless, an approximate estimate of the flowage of this stream at the site of the proposed dam. for the years 1895, 1896, 1897, 1903, and 1904 has been prepared and tabulated. This flowage of the Conasauga River was computed from the rainfall over the watershed above the proposed dam, on the assumption that the same percentage of rainfall reached the river as reached the Coosawattee River from the watershed above Carters. This assumption is probably not very wide of the mark, as the two watersheds are of very much the same character. This similarity of watersheds leads to the belief that the run-off of the Conasauga in dry years will probably be as large a percentage of the rainfall as was the run-off of the Coosawattee River in 1907. The 1904 flowage of 4,000,000,000 cubic feet from the Conasauga River above the proposed reservoir dam will give a discharge of 514 cubic feet per second at Montgomery for 90 days.

Mr. Truss reports a number of favorable dam and reservoir sites on the Tallapoosa River. Only those he describes as Nos. 5, 15, 17, 19, 22, 23, and 24 are considered.

Dam site No. 5 has a width at the water surface of 500 feet, and at a height of 100 feet above the water surface the width is 700 feet.

Dam site No. 15 has a width at the water surface of 250 feet, and at a height of 100 feet above the water surface the width is 450 feet.

Dam site No. 17 has a water surface width of 250 feet, and 135 feet above the water surface the width is 570 feet.

Dam site No. 19 has a water surface width of 250 feet, and 70 feet above the water surface the width is 590 feet.

Dam site No. 22 has a width at the water surface of 150 feet, and at 100 feet above the water surface the width is 500 feet.

Dam site No. 23 has a water-surface width of 600 feet, and at 76 feet above the water surface the width is 930 feet.

Mr. Truss reports conditions at the abutments as good, there being indications of solid rock underlying them.

In 1904 the percentage of rainfall that failed to reach the river was 71 per cent, comparatively a small loss, and due doubtless to the same causes given as an explanation of the small loss from the watershed of the Coosawattee River.

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[1] Not printed.

The discharge in 1904 at Sturdevant, Ala., was 60,000,000,000 cubic feet. The annual discharges at the several dam sites were computed from the ratios of the areas of the watersheds above them to the area of the watershed above Sturdevant.

Dam site No. 5 is probably the best on the river, as it lies below the junction of the Tallapoosa and Little Tallapoosa Rivers. Inspection of table of estimated flowage, etc., shows that the flowage of the Tallapoosa at dam site No. 5 and of the Etowah near Cartersville is practically the same; therefore it is safe to assume that the Tallapoosa can add 6,000 cubic feet per second to the flow of the Alabama River at Montgomery for 90 days.

Silt.—A device for catching silt was so arranged that the current flows freely through it until the doors or valves are closed, thus permitting an accurate sample of the silt-bearing water to be secured. With this device samples of Coosa River water were taken from May, 1908, to March, 1909. The six samples, numbered in Dr. H. B. Battle's report of April 30, 1909, as 11,330 to 11,335, inclusive, were taken during the freshet of February-March, 1909, the highest since the extreme freshet of 1886. The river, during this recent freshet probably carried a maximum quantity of silt, and the six samples were therefore taken under the worst possible silt conditions. Dr. Battle, in his chemical laboratory in this city, determined the relative volume of silt to the total volume of water in the six samples of Coosa River water described above, with the following results:

Sample No.	Marks.	Specific gravity of— Silt.	Specific gravity of— River water (when clear).	One volume of silt to stated volumes of water.
11330	No. 2. Sample of silt, Coosa River, taken Feb. 17, 1909, near mouth of Slaughter Creek, Coosa County, Ala. River was at the highest level of the freshet. Surface of water at the Narrows, 395.2	2.32	1.00009	5,182
11331	No. 3. Sample of silt, Coosa River, taken Feb. 27, 1909, near mouth of Slaughter Creek, Coosa County, Ala. River seemed to be on a stand, and at the highest of the freshet	2.38	1.00010	2,336
11332	No. 4. Sample of silt taken from Coosa River near mouth of Slaughter Creek, Coosa County, Ala., Mar. 2, 1909. River had fallen 2 feet below high water of Feb. 27	2.04	1.00011	1,488
11333	No. 5. Sample of silt taken from Coosa River near mouth of Waxahatchee Creek, Mar. 13, 1909. Water seemed to be on stand, but will probably go higher. (High elevation of water, 390.25)	2.32	1.00014	3,164
11334	No. 6. Sample of silt taken from Coosa River near mouth of Waxahatchee Creek, Mar. 18, 1909. Elevation of water surface, 388.61. Extreme high water reached Mar. 14, 1909, 392	1.90	1.00009	5,434
11335	No. 7. Sample of silt taken from Coosa River near mouth of Waxahatchee Creek, Mar. 22, 1909. Elevation of water surface, 388.91. Water was rising	1.79	1.00007	20,833

The average of the six samples is 1 volume of silt in 6,406 volumes of water. Sample No. 11332 has evidently too great a silt content, due doubtless to its having been taken from too near the mouth of Slaughter Creek. Nevertheless, it is included in the general average. It is probable, also, that the water at the proposed sites of reservoirs is freer from silt than are the samples.

Assuming that each year the entire silt burden from a discharge of 92½ billion cubic feet, equal to the discharge of the Etowah River at Cartersville, Ga., during the high-water year of 1903, is deposited in a reservoir there whose capacity is equal to the 1903 discharge, it will then require more than 6,000 years to fill the reservoir with silt.

NAVIGATION.

This discussion of navigation will begin with the navigation of the Alabama River, as it will be most benefited by any addition to its low-water flow. The minimum flow of the river occurred in 1904, the minimum discharge at Montgomery, Ala., being, in round numbers, 2,000 cubic feet per second. An addition of 6,000 cubic feet per second will give a low-water discharge of 8,000 cubic feet per second. Reference to Table No. 2 shows that at the Three Chutes Bar just below Montgomery a discharge of 8,570 cubic feet per second gave a gauge height there and on the Montgomery gauge of 1.9 feet. The minimum reading of the latter, 1904, was −1.9; therefore, an addition of some 6,000 cubic feet per second to the minimum discharge of the Alabama

River at Montgomery will give, on a slope of 1:2,000, an additional depth of 3.8 feet without any channel improvement.

The obstruction at Three Chutes is as serious as any on the river, except those at the cut-off in the lower Coosa and at the old mouth of the Tallapoosa, the head of the Alabama River. These last named will be discussed further on.

Careful observations were made to determine the value of n, the coefficient of roughness, in the Kutter formula. The results have been tabulated in Table No. 3. The mean value thus found was 0.03. By substituting this value of n in the Kutter formula:

$$C=\frac{41.6+\frac{.00281}{s}+\frac{1.811}{n}}{1+\frac{\left(41.6+\frac{.00281}{S}\right)n}{\sqrt{R}}}$$

C=Const. in Chezy formula,
n=Coef. of roughness=0.03,
s=Slope,
R=Hydraulic radius,
=Mean depth near Montgomery,

the value of C can be found for any values of s and R.

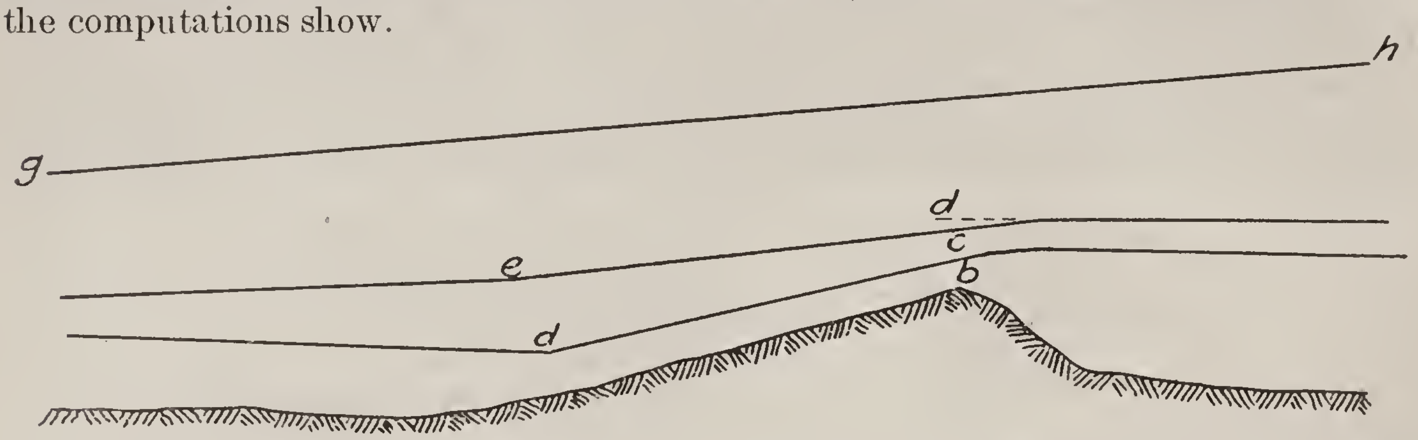
The transposed Chezy formula is: $b=\frac{Q}{C\sqrt{d^3 s}}$, in which b=width of channel, Q=discharge in cubic feet per second, d=mean depth, s=the slope. By substituting the computed values of C, the observed value of s and assumed values of Q and d, the widths of channel in Table No. 2 were computed for a slope of 1:2,000, and for discharges from 2,000 cubic feet per second to 12,000 cubic feet per second, inclusive.

Referring to Table No. 3 it will be seen that to obtain a channel depth of 4 feet with the minimum discharge of 2,000 cubic feet per second will require a channel width not exceeding 177 feet. An additional discharge of 6,000 cubic feet per second, or a total of 8,000 cubic feet per second, will give 4-foot depth with a channel width of 710 feet. This is greater than the average width of the river. A depth of 7 feet, with a discharge of 8,000 cubic feet per second, will require a channel width of not exceeding 276 feet. Such a channel can be maintained by dredging, supplemented in places by works of contraction.

An additional discharge of 8,000, or a total of 10,000 cubic feet per second, will give 7-foot depth of channel with a width of 345 feet, or a channel depth of 8 feet with a width of 276 feet. An addition of 10,000 cubic feet per second to the minimum flow of 2,000 cubic feet per second will give a 7-foot depth of channel without further improvement, and 8 and 9 foot depths with dredging and some little improvement by works of contraction.

The most serious obstructions in the lower Coosa and Alabama Rivers are the shoals at the Tallapoosa cut-off and the old mouth of that river, in the section between Wetumpka, at the foot of the Coosa Rapids, and Montgomery, on the Alabama. A survey and careful study have shown that the obstructions in this section can be overcome by dredging alone, except for some training dams at the cut-off and the old mouth of the Tallapoosa; and that the slopes over the shoals can be reduced to a uniform slope of 1 : 5,000. Referring to Table No. 3, it is seen that with a slope of 1 : 5,000 and a channel width of 281 feet, and the minimum discharge of 2,000 cubic feet per second, a 4-foot depth of channel can be maintained, and with less than 5,000 cubic feet per second a channel depth of 4 feet can be maintained without other improvement than the dredging necessary to reduce the slope. With a discharge of 8,000 cubic feet per second (6,000 cubic feet per second added to the minimum flow), a 7-foot depth of channel can be maintained with a width of 430 feet. Channel depths 8, 9, and 10 feet with a discharge of 10,000 cubic feet per second, can be maintained with channel widths of 428, 352, and 294 feet, respectively; and with a discharge of 12,000 cubic feet per second the same depths can be maintained with channel widths of 514, 422, and 353 feet, respectively.

Reference to Table No. 2 shows that on the shoals at the Tallapoosa cut-off, and at the old mouth of the Tallapoosa, the current velocities decrease as the Coosa and Alabama rise. It was not practicable to measure the slopes when each observation was made; but the decreased velocities indicate a decrease of slope, and this is theoretically correct, for, referring to the hypothetical, longitudinal section below, as the discharge increases, the velocity of the water is checked on reaching the lower pool by reason of the decrease of slope, and there is a piling up as at e until sufficient head is gained there to cause the velocity necessary to carry off the increased discharge, and the lower pool assumes the slope e–f. This piling up at e causes, of course, a decrease of slope c–e over the shoal, and the decrease of slope with increase of discharge continues until at high water, as at g–h, the river over shoal and pools assumes a uniform slope. The most serious obstruction to navigation is usually found at the head of shoals; this is due, in part, at least, to the loss of head (depth) c–d, due to the velocity of approach. When the slope *e–c* and the velocity on the shoal decreases, this loss of depth due to the velocity of approach becomes less. The benefit to navigation, due to increased flow from reservoirs or otherwise, would therefore be greater than the computations show.



The question of excessive velocities in the improved river may be raised. In this connection reference is made to Table No. 2, where it will be seen that the greatest computed velocity is 5.2 feet per second. Mr. O. E. Young, surveyor, in his report of March 19, 1909, describing accident to a current meter at Selma, Ala., on the 17th of that month, states that at the time of the accident the greatest velocity recorded was 8.4 feet per second, and that the steamboat *Nettie Quill* passed on the way up to Montgomery while he was engaged in the work, making the distance of 82 miles in 12 hours. The facts stated by Mr. Young show that the velocities to be expected in the improved channel are well within the requirements of navigation.

From Wetumpka, Ala., to Gadsden, Ala., a project for the improvement of the Coosa River for a 6-foot navigation by means of locks and dams was submitted by Capt. (now Maj.) J. B. Cavanaugh, which can be found in the Annual Report of the Chief of Engineers for 1905. Aside from the question of power, this project is probably the most economical that can be devised for the navigation named. It is now, however, proposed to develop the power on this part of the Coosa by the construction of high dams with flights of locks at each; but, as the proper place to discuss this new project will be under the head of "Power" its discussion will not be taken up here.

The lowest recorded discharge at Rome, Ga., was on October 7, 1903; there is no record for 1904. The gauge at that time read 0.2 foot and there was a corresponding discharge of 1,280 cubic feet per second; an addition of 6,000 cubic feet per second will give a reading of the gauge there of 4.3 feet. The low-water depth in the channel between Gadsden, Ala., and Rome, Ga., for that low-water period was 2½ feet; therefore, with the addition of 6,000 cubic feet per second to the low-water discharge of this part of the Coosa River there will be a minimum channel depth of 6.6 feet in pools and probably a 4-foot navigation in shoals, except at Horseleg Shoals, 1½ miles below Rome, at which obstruction a lock and dam is proposed.

The Oostanaula and Coosawattee Rivers are navigable for light-draft boats from Rome to Carters, at the foot of the mountains of northern Georgia, a distance of 105 miles. These rivers flow through a rich agricultural section, but if an extensive commerce is to be developed upon them, it is probable that they will have to be improved for slack-water navigation. A 4-foot navigation can, however, probably be maintained if a minimum flow of 4,000 cubic feet per second can be secured from reservoirs located upon the headwaters.

The Etowah River has never been navigable, except, perhaps, for timber rafts and flatboats, and if its improvement is undertaken it will have to be done by means of locks and dams.

POWER.

The elevation of the extreme low-water level of the pool below the rapids at Wetumpka, Ala., is 152; the elevation of the proposed power and navigation dam at Lock 2 is 535; the distance between the places named is 142¼ miles, the fall 383 feet. The minimum discharge at Riverside, Ala., near the head of the fall is 1,225 cubic feet per second; the minimum discharge at Wetumpka, 1,730 cubic feet per second; the mean, in round numbers, 1,500 cubic feet per second. This head and discharge will develope 65,284 horsepower. An additional discharge of 6,000 cubic feet per second from the Cartersville Reservoir, or a total of 7,500 cubic feet per second, with the same head, will develop 326,420 horsepower.

Assuming that a combined flow of 4,000 cubic feet per second can be obtained from other reservoirs on the headwaters of the Coosa River, then this flowage, together with the flow from the Cartersville Reservoir and the natural flow of the river, will give a minimum discharge of 11,500 cubic feet per second, and a power development of 500,510 horsepower.

Assuming that 75 per cent of the power can be utilized and 78 per cent efficiency, then the minimum, effective, primary power in each case is 38,182, 190,910, and 292,730 horsepower.

The above discussion considers only the minimum or primary power. There will be a secondary power quite as great available for eight to nine months each year.

Plans and locations for power dams in connection with the navigation of the Coosa River are being considered, and it is proposed to so design them as to serve the best interests of both power and navigation.

WHARFAGE AND TRANSFER FACILITIES.

Study has been made of wharfage and transfer facilities for Rome, Gadsden, Lock 3, Yellow Leaf, Wetumpka, and Montgomery, and outline plans have been prepared. On the ground now physically available it is practicable to provide at reasonable expense for all necessary wharfage and transfer facilities. The cities of Gadsden, Wetumpka, and Montgomery own sufficient wharfage area. It is understood that Rome is at the present time contemplating the purchase of proper wharf area.

SUMMARY.

The following statements are based on the minimum or 1904 flow of the rivers under discussion:

A reservoir on the Etowah River, formed by a 200-foot dam, near Cartersville, Ga., capable of maintaining a flow in the Alabama River through the low-water season of 8,000 cubic feet per second is practicable. Such a reservoir would probably afford a 4-foot navigation on the Coosa River between Rome, Ga., and Gadsden, Ala., without further improvement except at Horseleg Shoals. It would increase the effective minimum power on the Coosa from 38,182 horsepower to 190,910 horsepower. It would increase the low-water discharge of the Alabama River at Montgomery from 2,000 cubic feet per second to 8,000 cubic feet per second, the gauge height from −1.9 feet to +1.8 feet, and the minimum channel depth from 2½ feet to 6.2 feet.

Reservoirs on the Coosawattee and Conasauga Rivers are practicable; but the computations of the annual flow at the proposed sites are merely approximate. If further investigation, however, shows flowage great enough to furnish an additional discharge of 4,000 cubic feet per second during the low-water season, this water released from reservoirs at the proper time would probably afford a 4-foot navigation on the Oostenaula and Coosawattee Rivers, and thus do away with the need for locks and dams.

Added to the flow from the proposed reservoir near Cartersville, Ga., the combined flow would probably afford a 5-foot navigation on the Coosa between Rome and Gadsden, except at Horseleg Shoals. The combined flow would increase the effective minimum power on the Coosa from 38,182 horsepower to 292,730 horsepower.

The discharge of the Tallapoosa River at the site selected for a reservoir dam is capable of furnishing a flowage equal to that estimated for the Etowah River at Cartersville, Ga., namely, 6,000 cubic feet per second for 90 days or more. This flowage would, however, add nothing to the navigation or power possibilities of the Coosa River.

The shortage requirements of flow on the Alabama River at Montgomery increase rapidly. For example, if the minimum discharge required was 12,000 cubic feet per second, the deficiency of flow would have to be supplied from reservoirs for a period of approximately 6 months instead of the 90 days for a minimum flow of 8,000 cubic feet per second.

It has been shown that a possible flow from reservoirs at the headwaters of the Alabama River of 16,000 cubic feet per second for 90 days can be secured. This flowage will probably maintain a minimum flow at Montgomery of 12,000 cubic feet per second during the low-water season of the driest years. It will increase the gauge from −1.9 feet to approximately +3.3 feet and the low-water channel depth from 2½ feet to approximately 7.7 feet without regulation.

There is no silt problem involved in the consideration of reservoirs on these rivers, for, as already shown, it would require more than 6,000 years under the most unfavorable conditions to completely fill them with silt.

With the deep reservoirs proposed evaporation is negligible except when stored water is carried over from year to year, and even then the percentage of loss from this cause is small.

From experiments by this office, while far from complete, there appears to be little or no probability of loss between the reservoirs and points below.

The method of improvement by increased low-water flow from reservoirs furnishes probably the best solution of the problem of securing navigation on the Alabama and upper Coosa Rivers; and then, too, this storage at the headwaters of these streams increases the water powers upon them.

Such large alluvial streams as the Mississippi below the mouth of the Missouri and the Missouri itself below Kansas City would require such enormous additions to their minimum flow for small increases in channel depth as to make their improvement by means of storage reservoirs economically impracticable.

RECOMMENDATIONS.

(1) As a result of the recent preliminary examination, there is every reason to believe that the proposed storage reservoir on the Etowah River near Cartersville, Ga., will give the speediest relief to the navigation of the Alabama River by securing to that stream a minimum depth of 6 feet, and to the Coosa River, by a 4-foot navigation between Rome, Ga., and Gadsden, Ala., and that it will give to the people a power development of 190,910 horsepower, enough to supply the needs of the State of Alabama for a decade.

(2) A comprehensive scheme of improvement for this system of rivers would, as shown in the foregoing pages, include reservoirs on the Coosawattee, Conasauga, and Tallapoosa Rivers.

I therefore respectfully recommend:

(*a*) That in view of the statements in (1), a survey be made of the proposed reservoir site on the Etowah River near Cartersville, Ga., for the purpose of locating the dam and spillway; of ascertaining the area and ownership of flooded lands; the capacity of the reservoir; the location of mines, mills, and graveyards, if any, and of roads and railroads within the flooded area; for the purpose of taking gagings of the river at or near the proposed dam site, and the preparation of maps and estimates of the cost of the improvement.

Estimated cost of the survey, $15,000.

(*b*) That in view of the statements in (2), surveys be made of the reservoir sites on the Coosawattee, Conasauga, and Tallapoosa Rivers in sufficient detail to determine the area of flooded lands, storage capacities, and cross sections of dam and spillway sites; and in connection with the survey that gaugings be taken at or near the dam sites, and that maps and estimates of the cost of the final and comprehensive improvement be prepared.

Estimated cost of surveys, $5,000.

Total estimated cost of all surveys, $20,000.

Very respectfully,

D. M. ANDREWS,
Assistant Engineer.

Capt. H. B. FERGUSON,
Corps of Engineers.

APPENDIX B.

MINERAL RESOURCES OF THE COOSA DRAINAGE BASIN.

ALABAMA.

[Report of Dr. William F. Prouty, assistant geologist, State of Alabama.]

In discussing the mineral resources of the Coosa Drainage Basin the remarks will be confined in a large measure to the area of the basin within Alabama, through which area of about 4,000 square miles the Coosa is now navigable, or can readily be made navigable, by the proposed locks and dams. The drainage area of the Coosa River in Georgia is practically the same in amount as in Alabama, but the navigable Coosa would pass through a much smaller amount of this area, since a little above Rome the Coosa becomes rapidly smaller by numerous branchings toward its headwaters.

In general, the mineral deposits occurring in Alabama are extended on into Georgia and, following the strike of the rocks, run nearly parallel with the course of the Coosa River.

For the most of the way the Coosa River runs in a southwest direction along anticlinal valleys in large part worn in limestone and dolomite of Lower Silurian and Cambrian age. In the lower part of Talladega County, however, the river changes its course. It no longer follows the Paleozoic limestone valleys, but swings southwardly and thence southeastwardly across the older metamorphic rocks of the Crystalline area, through Chilton and Elmore Counties on to the junction with the Alabama River at Wetumpka. This brings the river for a long distance through the rich mineral deposits in and bordering the valley limestones, and thence, as it swings across the metamorphic region, it leads the navigable stream through the more varied mineral deposits of the crystalline rocks. The upper part of the Coosa, from Rome southwestwardly to about the beginning of the Coosa coal field, is a graded river and meanders on a flood plain, thus giving to its waters through here a fairly good depth and freedom from rapids and shoals. From this point, however, to Wetumpka the gradient of the river bed is much steeper, and throughout this area numerous locks and dams must be constructed to make the stream navigable. Thus there could readily be developed a large water power throughout that area where one finds the larger diversity of mineral resources.

The minerals of chief importance in the Coosa Drainage Basin are given below about in the order of their importance:

I. *Iron ores*—(*a*) *Brown hematite* "*Brown ores.*"—This ore occurs as a residual matter from the decomposed Upper Cambrian and Lower Silurian limestones which outcrop mainly in the central and eastern part of the Coosa Drainage Basin. The characteristic mode of occurrence is in irregular deposits or pockets in the red clay or loam. It is very difficult to estimate the amount of the brown ore reserves because of their pockety nature. E. C. Eckel, of the United States Geological Survey, has made what is by many considered a very conservative estimate of the brown ore reserves. A large percentage of the reserve as estimated for the State is found in the Coosa Basin. When the brown ore reserves from this basin in Georgia are added we should have as much as 75,000,000 tons from the Coosa Basin itself. These brown ore deposits are nowhere more than 15 to 20 miles from the Coosa River, and they are all comparatively near to one or another of the different railroads which traverse the basin. These deposits have been furnishing ore for furnaces at Anniston, Ironaton, Telladega, Tecumseh, Rock Run, Cedartown, Aetna, and Rome, and also a large amount of ore for shipment to the Birmingham district. An average analysis of the ores show a metallic iron content of about 50 per cent.

Recent investigations have revealed in addition the presence of a considerable quantity of brown ore in the metamorphic rocks in the vicinity of Verbena, Chilton County, near the Coosa River. There are doubtless numerous other deposits of a similar nature in the areas accessible to the Coosa River in Chilton, Coosa, and Elmore Counties.

(*b*) *Red hematite* ("*Red ore*").—The red hematite, which is the main ore of iron in Alabama, occurs in the Clinton formation of the middle Silurian strata and is a bedded deposit partaking of the dip and strike of the associated rocks. The deposits in the Coosa Drainage Basin are located to the north and west of the Coosa River and occur in beds running northeastwardly from Attalla and Gadsden along both sides of the Lookout Mountain syncline. The ores running northeast from Attalla pass by Fort Payne, Battelle, etc., and on into Georgia. The bedded deposits on the east side of the Lookout Mountain Syncline run parallel with the former across the State line into Georgia. In the neighborhood of Gaylesville and Round Mountain other bedded deposits occur still farther to the east and run parallel with the before-mentioned beds on into Georgia. While these deposits are much thinner than those close to Birmingham, they nevertheless contain a very large amount of workable red ore reserves. Mr. Burchard of the United States Geological Survey has made a very conservative estimate of the red ore reserves of Alabama. His estimates are as follows:

	Tons.
Whole red hematite reserve of the State	483, 730, 200
Lookout Mountain district reserve	125, 651, 100

This gives for the Alabama (Coosa) part of the district alone more than a fourth of the whole red iron ore reserve for the State of Alabama. For the total reserve one must add the rather extensive deposits in the Georgia part of the basin. The position of the railroads makes the development of these iron ore reserves very easy. The main furnaces now operating on this ore are located close to the Coosa River. There are four furnaces and an open-hearth steel plant at Gadsden, one furnace at Round Mountain, one at Rome, Ga., and another furnace not far from the Coosa River and connected with it by rail, at Attalla, and one likewise connected at Rock Run, Ala., two at Anniston, Ala., two at Ironaton, Ala., one at Talladega, Ala., and two at Shelby, Ala.

(*c*) *Gray ore* (*magnetite*).—This ore is found in the Coosa Valley in the pre-Cambrian or altered Cambrian rock, especially in Talladega County, Ala., but also to some extent in the same rock to the northeast on into Georgia. The deposits are more or less regularly bedded and the thickness of the workable beds varies from 3 to 40 feet along the strike. It is estimated that there are in Talladega County alone 60,000,000 tons of workable ore. The larger part of this amount is within 10 miles of the Coosa and very near the railroad.

An average analysis of the gray ore shows it to contain from 45 to 50 per cent metallic iron, an amount equal to that found in a good average brown ore. This ore being rather high in silica and in alumina gives good results mixed in the furnace with the more calcareous red ores or with the brown ores. It could also be readily smelted alone if circumstances rendered this advisable.

(*d*) *Pyrite.*—Deposits of pyrite of considerable importance occur in a bed of green schist which runs along the eastern flank of Talladega Mountain. Near Gold Branch in Coosa County, and near Dean in Clay County, mining operations of some magnitude have been carried on. For several miles northeast from Dean the bed of pyrite appears to be at its best, being several feet in thickness and free from impurities. An analysis of the pyrite shows 44 per cent sulphur and 8 per cent copper. The vein about Pyriton will average 8 feet in thickness, sometimes getting to be 20 feet.

Estimating from the thickness, the surface outcrop and the depth to which the ore can be mined, the amount of available ore has been placed at 48,000,000 tons. This ore is useful not only as a source of sulphur but the cinder will yield a sufficient amount of copper to make its extraction profitable.

II. *Coal.*—A large percentage of the minable coal of the Coosa coal field is readily accessible to the Coosa River, since the river nearest approaches the field in the proximity of the basins that are the most productive. These basins are the Coal City-Blackable, the Fairview, and the Ragland. From these basins the river is in no place distant more than 6 miles and in many places it is very close to them. Prof. McCallie has estimated the available coal in the Coosa field at 600,000,000 tons, all of which would naturally find its nearest outlet by the Coosa Basin.

III. *Building and ornamental stones.*—(*a*) *Marble.*—Almost inexhaustible quantities of a high-grade marble occur in a belt running nearly parallel with the Coosa River and in places less than 10 miles from it. This belt has a length of at least 60 miles and a width of outcropping rocks of one-quarter mile, running through the northwest portion of Coosa County, through Talladega County, and thence on into Calhoun. The best marble yet found occurs in Talladega County. The principal quarries from which the stone has been obtained are in the vicinity of Sylacauga and near Taylors Mill on Talladega Creek. The marble in this belt is a rather pure lime carbonate (97 per cent) and has been used as a flux. This marble is receiving very wide attention and bids fair to rival the well-known Vermont marble in the markets. A dolomitic marble of very good quality also occurs on the very banks of the Coosa in Chilton and Coosa Counties. The Trenton and Cambrian limestones are often in places beautifully variegated in a manner similar to the Tennessee marble.

(*b*) *Granites.*—Granites of the very highest grade for building and ornamental purposes occur in very large quantities and in positions very favorable for quarrying in many places in Elmore, Chilton, and Coosa Counties and not far distant from the river.

(*c*) *Sandstones.*—Building stones of this nature occur in many places, especially in the subcarboniferous measures to the west of the river and in the Cambrian formation on the east side of the river in the Paleozoic districts. Many of the handsome buildings about Anniston are made from the Cambrian sandstones.

(*d*) *Limestone.*—The Pelham limestone occurs in vast quantities close to the Coosa River in many places where it could be quarried with very small cost. It is a most excellent building stone as well as a high-grade lime, fluxing, and cement rock. Under this head should also be mentioned the Knox limestones and dolomites which are often high-class building materials. It is through these latter rocks that the Coosa runs for the larger part of its way in the basin.

IV. *Lime and cement.*—The limestone which is best suited for burning into quicklime and for manufacturing into Portland cement in the Coosa Basin is the Trenton limestone. This stone is found in great abundance in the basin, especially on the western side near the coal measures. Here also are found the very best grades of shale and clay suitable for mixing with the lime in the manufacture of Portland cement. The Trenton limestone outcrops in numerous places along the river where the rock could be quarried and shipped at a very low cost. The marbles which lie to the east of the river are a very pure limestone and would make most excellent quicklime and mixed with the residual clays in that district would make a most excellent Portland cement.

V. *Clays.*—Kaolin, or china clay, has been found at Rock Run, Cherokee, County; Gadsden, Etowah County; Kymulga, Talladega County; Fort Payne, Dekalb County, in Alabama, in the basin proper; and just to the east, in Randolph County, Ala., 4 miles north of Louina extensive beds occur.

Fire clay is found in the Coosa coal fields, and most excellent brick and pottery clays occur both in the Coosa coal field and in the subcarboniferous shales bordering the coal fields. The proximity of clay and coal makes the clay-working industries profitable in many places, and the presence of both railroads and navigable water would add greatly to the shipping advantages.

VI. *Bauxite.*—This mineral occurs in the Knox dolomite of the Lower Silurian rock and is found here and there in a belt some 10 miles wide extending northeast through Talladega, Cleburne, Calhoun, Etowah, Cherokee Counties, Ala., and on into Georgia.

On the expiration of the patents under which the manufacture of aluminum is now held as a monopoly the manufacture of the metal should be added to the industries of the State since the deposits are near cheap water power for electric generation.

VII. *Slates.*—Slates which appear from their surface outcrop to be of promising quality and large in amount occur in many places in Talladega, Calhoun, Shelby, Coosa, and Chilton Counties, near the Coosa River. The slates are from several formations: The Talladega, the Weisner, the Montevallo, and the Upper Trenton.

Of these the best are perhaps the slates of the Weisner, occurring in the southwestern part of Talladega County; those of the Montevallo group in Chilton County; on Buxahatchee and Clear Creeks; and those of the Trenton in the "Dark Corner" northeast of Anniston, in Calhoun County.

Quarries have been started in several localities, but have been carried to no greater depth than 20 to 25 feet, not below the reach of weathering, so that adequate tests have not yet been made.

VIII. *Graphite.*—This mineral has been worked at several points in Coosa and Chilton Counties near the river. Some of the graphitic schists hold as much as 20 per cent of graphite, but the average content is much less. With advancing means of concentration, the graphite industry bids fair to be one of considerable importance throughout the region of its occurrence in the metamorphic rocks.

IX. *Mica.*—This mineral is found in large crystals and in segregations in the coarse-grained granite (pegmatite) veins cutting through the mica schists, especially well developed in Chilton, Coosa, Clay, and Randolph Counties. Considerable prospecting and mining has been done in several places, and a large amount of mica is known to occur in the counties named.

X. *Asbestos, corundum, and soapstone* occur locally in the mere basic rocks of the crystalline area in places near the river, and may, especially the soapstone, be a source of considerable revenue in the not distant future.

It is seldom that nature has placed in a single small river basin mineral resources so vast and so varied as are those found in the Coosa Basin. Its chief minerals are those that are the most advantageous to the development and progress of civilization; the iron ores, cement material, building stones of all kinds, fuel and clays, to which are added with a liberal hand many useful accessory minerals.

Of the iron ores the Coosa Basin has probably more than 300,000,000 tons; of coal, about twice that amount; of limestones and marbles of the purest and best grades, more than can ever be used; of building stones of the best quality and variety; and of clays and cement materials, an inexhaustible supply. It seems useless to try to do justice to the natural advantages of the Coosa Basin in regard to its mineral content and their arrangement, and still more useless when we consider all its other natural resources, which are tending to make the basin a great center of manufacture and commerce, sending out its products by rail and stream to the world at large and receiving by both routes the necessary materials in return.

It would seem prodigal for us long to delay the manufacturing of our own minerals into the finished products. To this end we need a navigable waterway to the Gulf and the development of our water powers, even more than we would were we to ship our raw products elsewhere for manufacture. It is also to be noticed that every mineral industry that develops because of cheaper transportation by water will give to the railroads more and more work to do in bringing the products from the mine to the mill.

GEORGIA.

[Condensed from bulletins of Geological Survey of Georgia, by Drs. McCallie and Watson.]

Brown iron ores.—The brown iron ores, in workable quantities, are limited to certain well-defined districts.

The Polk County deposits are naturally divided into six distinct divisions, namely: The Cedartown district, the Fish Creek district, the Wray district, the Esom Hill district, the Etna Valley district, and the Aragon district.

The area embraced in the Cedartown district is from 1 to 2 miles wide, and about 8 miles long.

The Etna Valley district lies in the extreme western part of the county, along the Selma branch of the Southern Railway. This iron-bearing belt, which is about 2¼ miles wide and 5½ miles long, enters the county from Alabama at Etna station and follows the valley of the same name to within a short distance of Cave Spring.

The ore deposits of the Fish Creek district occur along the headwaters of a stream of the same name. The most extensive workings of this district are the Grady and the Central Mining Co.'s banks at Grady station, on the East & West Railroad, 6 miles east of Cedartown. This district, which has a northeast and southwest trend, is about 4 miles long and from 1 to 1½ miles wide.

The Aragon district is not so extensive as the other districts heretofore described. However, it has furnished a large quantity of ore. The main deposits occur in a narrow belt on both sides of the Southern Railway between Aragon and Seney.

The two remaining districts, namely, the Esom Hill and the Wray districts, are both located in the southwestern portion of the county. The former deposits occur along the East & West Railroad, near the Georgia-Alabama State line, and the latter along the headwaters of Lime Creek. Neither of these districts is very extensive, but the ore is usually of high grade.

The Bartow County iron deposits arrange themselves geographically into the following divisions, namely, the Eastern district, the Iron Hill district, and the Linwood district. The most important of these divisions is the Eastern district, which is confined chiefly to the metamorphic region in the eastern part of the county. The iron deposits of this district begin on the Jones property, about 2 miles south of Emerson, and extend in a northerly direction to Sugar Hill, a distance of about 16 miles. The width of the iron-bearing belt varies from 1 to 4 miles. It reaches its greatest width a short distance north of Emerson, where numerous iron banks have been worked in the quartzite ridges. Some of the most important brown iron ore deposits of the State, such as the Sugar Hill ore banks, are located in this district. In addition to the brown iron ores there is also in this district considerable hematite of the variety micaceous hematite, which is in places of sufficient abundance to be of economic value.

The two other iron districts are located in the western part of the county. The deposits of the Iron Hill district occur in the vicinity of Ligon post office, some 7 miles southwest of Kingston. The district is about 2 miles long, and half a mile wide. Its longer axis runs north and south, corresponding to the course of the ridges, traversing this part of the county.

The Linwood district lies along both sides of the Western & Atlantic Railroad between Linwood and Adairsville. The deposits here are scattered through the chert ridges, covering a considerable area, but none of them appear to be of any great economic value.

There are only two districts in Floyd County in which iron ore has been worked to any considerable extent. One of these is located in the southern and the other in the eastern part of the county. The former is known as the Cave Spring district and the latter as the Silver Creek district.

The Cave Spring district is an extension of the Cedartown district. It is only about 3 miles long and not over a mile broad. However, it has some of the most extensive and valuable deposits in the county.

The Silver Creek district has so far furnished but a small amount of ore. Nevertheless, there is to be found here in places considerable deposits along the hill slope, in the vicinity of the Chattanooga, Rome & Southern Railroad.

Fossil iron ores.—The fossil iron ores of Chattooga County occur along the line of knobby hills at the base of Lookout Mountain, both north and south of Menlo or Dirtseller Mountain, near the Georgia-Alabama line, and on Gaylors and Taylors Ridges farther to the south and west. The aggregate length of these four different lines of outcroppings is approximately 25 miles. The most extensive of these outcroppings, and the one which has been worked the most, is the line of outcroppings along the base of Lookout Mountain, here described in detail.

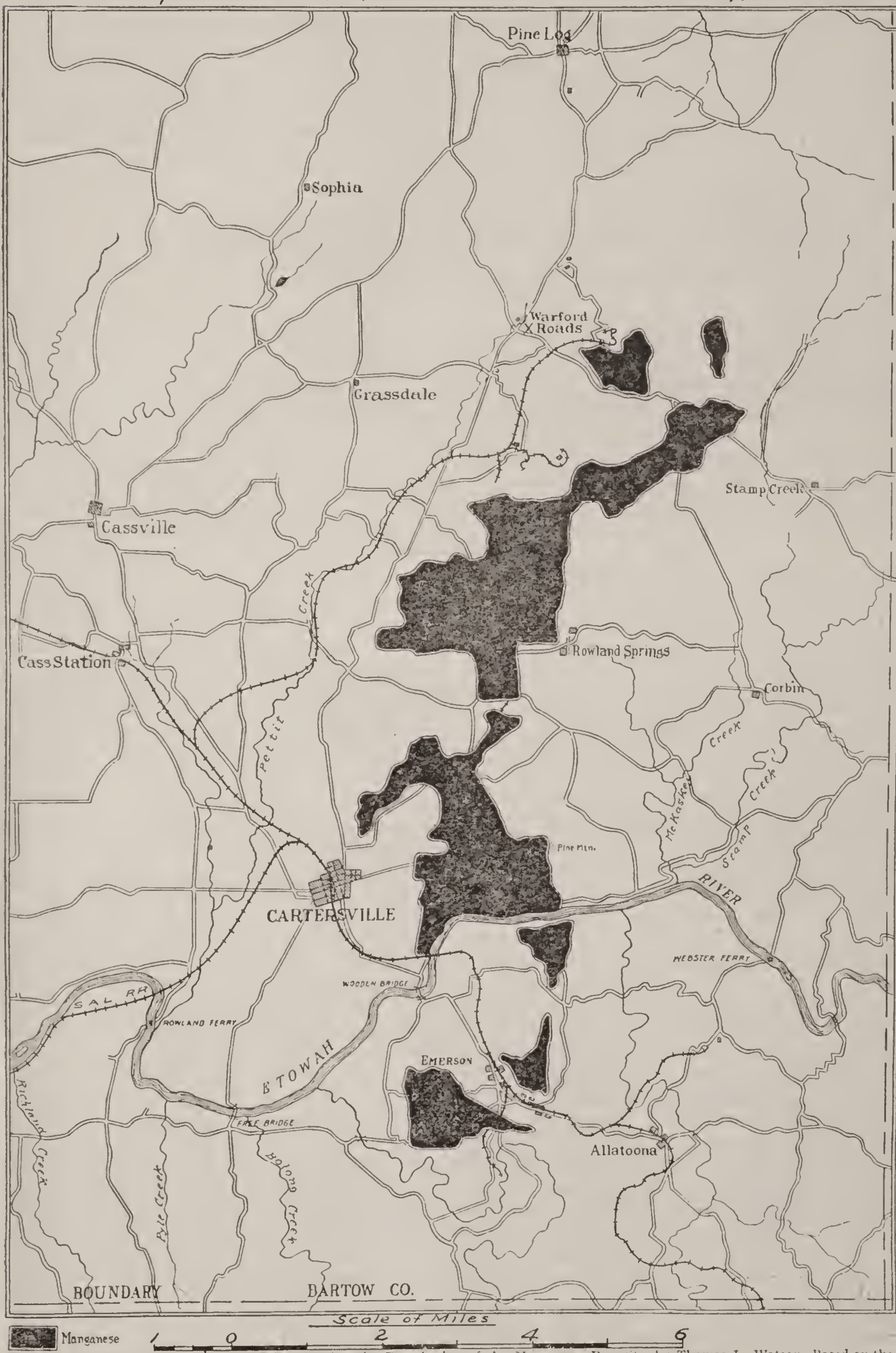
The fossil iron ores of Whitfield County are confined to Taylors and Dicks Ridges in the extreme western portion of the county. These ridges are the northern extensions of the two fossil iron ore-bearing ridges of the same name, previously described, traversing the eastern portion of Walker and Chattooga Counties. The ore in neither of these ridges has been worked to any extent within the limits of Whitfield County; however, there are many places where the float ore is to be seen strewn about the hillsides.

Bauxite.—The known distribution of bauxite in commercially workable deposits is exceedingly limited. At present the known workable deposits of this mineral are limited exclusively to a few localities in Europe and the United States. Its occurrence in Europe is in France, Germany, Austria, and Ireland; and, in the United States, in the Coosa Valley of Georgia and Alabama, and in Arkansas and New Mexico.

The distribution of the ore bodies, so far as known in Georgia, is shown on the accompanying map. The deposits are limited to six contiguous counties, namely, Walker, Chattooga, Gordon, Bartow, Polk, and Floyd, which constitute the middle and south parts of the so-called Paleozoic group, in northwest Georgia. Of these, Bartow and Floyd Counties include the vast majority of the ore bodies, grouped into fairly well-defined districts.

Manganese.—Commercially valuable ores occur in the northwest corner of Georgia, or the Paleozoic area, which are separated on the east and south from the Crystalline area by the Cartersville fault, the occurrence being in Cartersville district and Cave Springs district. Uses are for alloys, oxidizing, and coloring materials.

Manganese in Georgia; Etowa, Coosa and Tallapoosa Rivers. Preliminary Examination, Report of June 1, 1909. *MAP NO. 7. Appendix B.*



Map of the Cartersville District, Georgia, Showing the Distribution of the Manganese Deposits, by Thomas I. Watson, Based on the Cartersville Topographic Sheet, U. S. Geological Survey.

Ocher.—The ocher belt, as shown on the distribution map, has an approximate length of about 8 miles in a nearly north-south direction. As indicated by natural outcrops and prospect pits, the belt is a very narrow one, not exceeding 2 miles at the widest point.

APPENDIX C.

Summary of iron and coal development, Coosa River Valley, Alabama and Georgia.

[Compiled by U. S. Engineer Office, Montgomery, Ala.]

FURNACES.

Name.	Location.	Number.	Yearly tonnage.
Silver Creek Furnace Co	Rome, Ga	1	36,000
Cherokee Furnace Co	Cedartown, Ga	1	18,000
Round Mountain Iron & Wood Alcohol Co	Round Mountain, Ala	1	[1] 6,500
Bass Foundry & Machine Co	Rock Run, Ala	1	15,000
Tecumseh Furnace Co. (old)	Tecumseh, Ala	1	[1] 18,000
Alabama Consolidated Coal & Iron Co	Gadsden, Ala	2	220,000
Southern Steel Co	do	1	[1] 110,000
Quinn Furnace Co	do	1	[1] 18,000
Eagle Iron Co	Attalla, Ala	1	[1] 18,000
Woodstock Iron & Steel Corporation	Anniston, Ala	2	175,000
Jenifer Furnace Co	Jenifer, Ala	1	[1] 45,000
Alabama Consolidated Coal & Iron Co	Ironaton, Ala	2	220,000
North Alabama Coal, Iron & Railway Co	Talladega, Ala	1	[1] 50,000
Shelby Iron Works	Shelby, Ala	2	50,000
Total capacity		18	999,500
Producing, April, 1909		8	331,500

IRON-ORE MINES.

Name.	Location.	Yearly tonnage.
Etowah Development Co	Cartersville, Ga	[2] 75,000
Southern Steel Co	Sugar Hill, Ga	[1] 150,000
Tennessee Iron & Coal Co	Emerson, Ga	[1] 120,000
Pitts-Bartow Mining & Manufacturing Co	Bartow, Ga	[3] 90,000
Virginia Iron & Coal Co	Cartersville, Ga	[3] 45,000
B. C. Sloan	do	[2] 18,000
Grady Iron Co	Grady, Ga	[1] 60,000
Alabama & Georgia Iron Co	do	[2] 35,000
Independent Mining Co	do	[1] 30,000
Woodstock Iron & Steel Corporation	Cedartown, Ga	[2] 100,000
Round Mountain Co	Round Mountain, Ala	[2] 1,700
Southern Steel Co	Galesville, Ala	[1] 30,000
Dirtseller Mountain Mines	Cedar Springs, Ala	[1] 12,000
Alabama Consolidated Coal & Iron Co	Hematite, Ga	([1])
Southern Steel Co	Oremont, Ga	[1] 40,000
Pipers Mines	Priors, Ga	([1])
Etna Steel & Iron Co	Etna, Ala	[2] 4,000
Birmingham Coal & Iron Co	Tecumseh, Ala	[2] 40,000
Signans Mines	Bluffton, Ala	[1] 12,000
Parsons Mines	Langdon, Ala	[2] 6,000
Bass Foundry & Machine Co	Rock Run, Ala	[2] 25,000
Alabama & Georgia Iron Co	Frog Mountain, Ala	[1] 75,000
Sparks & Simmons Co	Cave Springs, Ga	[2] 5,000
Morris Mining Co	Morrisville, Ala	[2] 20,000
Hammond Mining Co	Gadsden, Ala	[2] 18,000
Alabama Consolidated Coal & Iron Co	Gadsden and Attalla, Ala	[2] 162,000
North Alabama Mining Co	Attalla, Ala	[1] 48,000
Costello Mining Co	Citico, Ala	[2] 16,000
Southern Steel Co	Crudup, Ala	[1] 130,000
Jenifer Furnace Co	Jenifer, Ala	[1] 50,000
Talladega Furnace Co	Talladega, Ala	[1] 60,000
Alabama Consolidated Coal & Iron Co	Ironaton, Ala	[2] 230,000
Shelby Iron Works	Shelby, Ala	[2] 50,000
Chilton County Mines	Verbena, Ala	[2] 11,000
Total		1,768,700
Producing, April, 1909		816,700

[1] Now temporarily closed owing to recent financial conditions.
[2] In operation.
[3] Building.

Summary of iron and coal development, Coosa River Valley, Alabama and Georgia—Continued.

COAL MINES.

Name.	Location.	Yearly tonnage.
Southern Steel Co	Altoona, Ala	[1] 300,000
Independent Co	do	[2] 30,000
Line Creek Coal Co	Sligo, Ala	
Sligo Coal Co	do	[2] 82,000
Ragland Coal Co	Ragland, Ala	[2] 40,000
Seaboard Coal & Coke Co	Coal City, Ala	[2] 50,000
Vulcan Coal Co	do	[2] 15,000
Normal annual total		517,000
Producing		217,000

[1] Now temporarily closed owing to recent financial conditions. [2] In operation.

LETTER OF MR. J. M. ELLIOTT, JR.

GADSDEN, ALA, *April 7, 1909.*

DEAR SIR: Further answering your favor of March 16, and referring to my letter of March 1, 1904, a copy of which I herewith inclose, I beg to say that the estimated tonnage of iron and coal made at that time, based on the output of the mines opened and worked on property located on the same vein, justifies the estimate of the number of tons of ore at 250,000,000 and that of the coal at least 300,000,000.

Since writing my letter of 1904 the Southern Steel Co. has bought the coal mines, which are located in close proximity to the coal fields located on Blount Mountain, mentioned in my letter, and have demonstrated the fact that this coal is of superior quality and that the tonnage can safely be estimated at two and one-half to three times as much as was first expected of these mines.

The Alabama Iron & Steel Co. and the Elliott-Chapman Coal & Coke Co., of which I am still president, have increased their holdings, and we are buying up every available lot offered for sale, with the expectation of it becoming very valuable and with the expectation of developing it whenever the market justifies doing so. We think the opening of the Coosa River would do much toward developing this property. The iron-ore mines located at Attalla, which are located on this same vein, have proven to be one of the most valuable mines in north Alabama. The owners of these mines have their furnaces located on the banks of the Coosa River, just above Gadsden about one-half mile. The tonnage from these furnaces amounts to several hundred tons per day.

I am sending a map[1] showing the location of the iron and coal fields and their proximity to the Coosa River. There are valuable ore deposits on both sides of the Coosa River all the way from Wetumpka, Ala., to Rome, Ga., and should the Oostanaula and Etowah, which form the Coosa at Rome, Ga., be made navigable, they both reach into a large territory of mineral deposit of ore. The valley of the Coosa is fertile and susceptible of being put into high state of cultivation, and I am satisfied that between Rome, Ga., and Wetumpka, Ala., 100,000 bales of cotton can be produced annually. Some 35 years ago I was steamboat captain on the Coosa River, and know thoroughly the value of the farm and mineral lands adjoining this river. We then handled more than 50,000 bales of cotton yearly, and we kept four steamboats busy handling merchandise between Rome, Ga., and Greensport, Ala. At that time there had been no improvements on the Coosa River, yet our boats ran every day in the year. The railroads coming into this country caused developments to be made along the railroads, and as the Coosa River could only offer transportation to local points, the development naturally ceased along the river and went toward the railroads. The Coosa during all these years has been neglected and not open to transportation, hence the tonnage has not come to the river. What is needed is to open up the river to navigation, so that through shipments can be made to Mobile and out to the Gulf and then to all parts of the world. I believe the development along the Coosa will more than pay for the expense, to say nothing of the wonderful development of electrical power, which can be turned into thousands of horsepower, which is now going to waste, into effective industrial enterprises that will not only give employment to

[1] Not printed.

thousands of people, but create a tonnage that can scarcely be approximated at this time, but in my opinion so large that the work done on the Coosa River should be on a much larger scale than that which has heretofore been done at Locks 1, 2, and 3, near Greensport, Ala.

You will note from the map which I am sending you that the coal lands of the Elliott-Chapman Coal & Coke Co. are located on Blount Mountain, and are shown by the crossed blocks. The odd section on Blount Mountain carries the same coal vein as ours, so we estimate that the total acreage of coal on Blount Mountain is near 50,000 acres. The mines opened and operated by the Southern Steel Co. are located at Altoona, as shown on the map by the finger point. You will note that the spring branches which form the Locust and Blackburn form of the Warrior River are located among the hills on the highest point of Blount Mountain. The streams shown on the map are spring branches, and while they will offer water for mining purposes they are too small to ever be considered of any value, except for that purpose.

The Louisville & Nashville Railroad within the last two years has built a railroad through and along Blount Mountain, giving transportation to Gadsden for ore and coal that will deliver these minerals on the banks of the Coosa River at a cost of a small switching charge. This is being done now for the furnaces located at Gadsden.

You will also note that the iron-ore vein shown in solid white blocks is located between the coal fields and the Coosa River and practically along the same line as the coal. The coal lands extend north of Altoona, as indicated by the zigzag white line which I have made on the map. This coal is also being mined at a point farther north than is shown by the map.

If I can be of further service to you, I am yours to command.

Very respectfully,

J. M. Elliott, Jr.

Capt H. B. Ferguson,
Corps of Engineers.

Appendix D.

Letter of Alabama Marble Co.

Gantts Quarry, Ala., *April 30, 1909.*

Dear Sir: Under date of March 16, 1909, I received from you an inquiry relative to a probable effect of the development of the Coosa River on the marble industry in Alabama.

I have not answered sooner because for one thing I have been away from the quarry a great deal, and for another, I have been endeavoring to get some information relative to other companies which are incorporated with a view to the development of marble quarries in this region. I will endeavor to answer your questions fully and accurately as I can, although, in some respects, my information is not as complete as it might be.

Question A. *Total amount of marble available considered tributary to the Coosa River.*—This is an extremely difficult question to answer. From what we know of the outcrops which we are working, and the information we have obtained by taking out cores ourselves, I am personally satisfied that this deposit extends for a distance of 40 miles, and that there is in it an available amount of white marble equal to eighty thousand million cubic feet, at the very least. Besides this, there is at least three times as much blue marble in the same deposit. However, there are other marble deposits in this county, all of them tributary to the Coosa River. In my judgment, if every other marble deposit in the world were totally abandoned, and the deposit in Alabama were fully developed, it would supply the demand of the entire world for marble for several thousand years, at the very least. So that you may say that the quantity of marble here is practically inexhaustible.

Question B. So far as I know, the following is a list of companies organized for the development of Alabama marble, including this one:

First. Alabama Marble Co., Gantts Quarry, Ala., capitalization............	$500,000
Second. Alabama Marble Quarrying Co., Sycamore, Ala., capitalization ...	300,000
Third. Bishop Alabama Marble Co., Talladega Springs, Ala., capitalization.	500,000

In reference to the capitalization of this last company, I am not perfectly sure, but I think that $500,000 is its capitalization.

Up to the present time this company, that is, the Alabama Marble Co., with headquarters at Gantts Quarry, Ala., is the only one that has really carried the development of Alabama marble far enough to demonstrate what there may be in it.

Question C. *Output to date per annum.*—The output of the quarry has averaged somewhat more than 100,000 cubic feet per year. We have increased it now so that we expect from now on to make anywhere from 125,000 to 200,000 cubic feet per year at this point alone.

Question D. *The probable output in future years under assumption of an improved river and an unimproved river.*—This is an exceedingly difficult question to answer. However, I am personally convinced that there is in the portion of the United States that we can easily reach now by rail, and on a competitive basis as to freight rates, a market for as much as 1,000,000 cubic feet of Alabama marble per year; that is, the market will easily take that output by the time we increase our capacity to that point. This would be a business quite as large as the business of the Vermont Marble Co., at the present time, which is the largest marble concern in the world. It is my judgment that if the Coosa River were improved, we could develop a considerable business on both the east and west coasts of South America, and in the West Indies, and in Mexico, as all of these countries import and use a large amount of Italian marble at the present time. Moreover, with the improvement of the Coosa River and the completion of the Panama Canal, we could reach the Pacific coast of the United States on such terms as to freight that we could compete with the Italian and other marbles along the Pacific coast of our own country. I think it is probably a reasonable estimate to say that if the river were improved, it would probably double the amount of marble that could be sold from the Alabama marble field. I regard the estimates of quantities that I have made as extremely conservative. The market for marble is increasing so rapidly right here that it would not surprise me at all if, within 20 years from now, the actual demand for Alabama marble should be at least five times as great as the maximum amount that I have estimated.

Question E. *Names of other companies.*—I have already given you this information under the answer to question B.

Question F. If the Coosa River were opened up, there would be a great many advantages, especially if its development for navigation were accompanied by development for water power. In that case, I think that it is probable that every marble mill and manufacturing plant in Talladega County would go to the Coosa River, because then it would be able to get its sand brought to it by water; probably its coal also. That would save a very material item indeed in the operating expenses of the plant. In the second place, the river would assure an abundance of water for manufacturing purposes, and a convenient means of discharging the waste. The availability of electrical power would be a great boon, because it is probable that the electrical power would not cost as much as power developed by the consumption of coal, even at the low rates now prevailing in Alabama, and, moreover, it would be possible always to expand a plant indefinitely without having to worry about a power plant, there being an abundant source of power close at hand to be had for the asking. My own personal opinion is that if this Alabama marble field is properly worked and developed, that within 50 years there will be a marble business here amounting, all told, to probably $20,000,000 per year. I believe that if the Coosa River were improved for navigation and power, that with the various incidental advantages that would accrue thereto, the marble business might easily be double what it would otherwise be in Talladega County, Ala.

Very truly, yours,

Alabama Marble Co.,
John Stephen Sewell,
Vice President and General Manager.

Capt. H. B. Ferguson,
Corps of Engineers.

Appendix E.

Cement, Limestone, and Clay Products.

[From official and technical reports of the Atlantic & Gulf Portland Cement Co.]

New cement plant at Ragland, Ala.—The lime deposits of the Coosa Valley are regarded as probably the richest and most extensive to be found anywhere in the United States. These lime deposits are found in great cliffs of pure limestone towering up over the river and valley hundreds of feet high. It is conceded that the lime of the Coosa Valley is unequaled anywhere in purity. The annual resources of the Coosa Valley derived from agriculture, timber, iron ore, lime, coal, and manufactured products aggregate over $52,000,000, a production which is increasing with each year. Of this grand annual total, manufactured products, chiefly pig iron, car wheels, bar iron, cast-iron pipe, lime, and cotton goods and yarns constitute over $28,000,000. With the completion of the improvements of the Coosa River already completed for a distance of two-thirds its length, the products of this wondrous valley, in addition to the present excellent railroad facilities, will have a splendid water highway to the sea, placing this valuable and ever-increasing production at lowest freight cost in easy access to the markets of foreign countries.

Location and transportation facilities.—The company's properties at Ragland are, in their physical characteristics and geographical location, ideal as a location for a cement plant. Upon the same property, and easily accessible, there is practically an inexhaustible supply of limestone, shale, and coal, the three materials essential to Portland cement manufacture. The climate of northern Alabama is mild and equable, rendering it unnecessary ever to close the plant or the quarries on account of stress of weather. The company possesses unusual advantages in respect to transportation facilities. The main line of the Birmingham & Atlantic division of the Seaboard Air Line Railroad runs through its properties. The company will extend for half a mile the line of railway connecting the mills with the limestone quarry to the Coosa River, where wharves will be constructed and connection made with the steamers of the Coosa River Navigation Co.

On the lands of the company at a low calculation there are from 25,000,000 to 30,000,000 tons of coal and 150,000,000 to 200,000,000 tons of limestone and shale, which can be converted into Portland cement at a cost not exceeding $1.75 per ton of cement.

The capital of the above company is reported as $1,000,000. The inspector from the Montgomery (Ala.) Engineer office reports foundations already completed for some of their buildings. Map showing relation of shale, limestone, coal, and the Coosa River, is herewith.

Cement works.

Name.	Location.	Annual capacity.
		Barrels.
Southern States Portland Cement Co	Rockmart, Ga	350,000
Piedmont Portland Cement Co	Davittes, Ga	(1)
Howard Hydraulic Cement Co	Kingston, Ga	90,000
Atlantic & Gulf Portland Cement Co	Ragland, Ala	[1] 600,000

[1] Building.

Limestone quarries.

Name.	Location.	Annual capacity.	
		Lime.	Limestone.
		Tons.	*Tons.*
Ladd Lime & Stone Co	Cartersville, Ga	7,000	35,000
Alabama Consolidated Coal & Iron Co	Zuber, Ala		185,000
Anniston Lime & Stone Co	Cobb City, Ala	11,000	
Legarde Lime & Stone Co	Legarde, Ala	12,000	53,000
Woodstock Iron & Steel Corporation	Rock Springs, Ala		100,000
Shelby County Lime Kilns	Calera, Ala	50,000	
Total		80,000	373,000

Brick works.

Name.	Location.	Capacity (per day).	Production (per day).
		Number.	*Number.*
Childersburg Brick Co	Childersburg, Ala	30,000	
Alabama High Grade Brick Co	Sylacauga, Ala	32,000	
Cartersville Brick Co	Cartersville, Ga	30,000	20,000
Mansfield Slate Brick Co	Rockmart, Ga	40,000	14,000
Rome Brick Co	Rome, Ga		30,000
Crucial Brick Co	do		30,000
Wilpicoba Clay Works	Ragland, Ala	21,000	15,000
Robinson Brick Co	Riverside, Ala	35,000	

Total capacity, 250,000 brick per day=600 tons per day=200,000 tons per year.

APPENDIX F.

List of cotton factories in Coosa River Valley.

[Compiled by United States Engineer office, Montgomery, Ala.]

Name of town.	Name of factory.	Number of spindles.
Anniston, Ala	Anniston Cordage Co	3,000
Do	Anniston Manufacturing Co	12,628
Do	Anniston Yarn Mills	5,304
Do	Woodstock Cotton Mills	10,000
Do	Adelaide Mills	4,896
Do	American Net & Twine Co	15,000
Do	Anniston Knitting Mills	
Do	Anniston Carpet Co	
Gadsden, Ala	Dwight Manufacturing Co	63,000
Jacksonville, Ala	Ide Cotton Mills	36,000
Pell City, Ala	Pell City Manufacturing Co	21,600
Piedmont, Ala	Coosa Manufacturing Co	27,600
Speigner, Ala	State Cotton Mills	3,500
Sycamore, Ala	Sycamore Mills	14,900
Do	Sycamore Knitting Mills	
Sylacauga, Ala	Central Mills	22,400
Do	Marble City Hosiery Mills	
Talladega, Ala	Cinnabee Cotton Mills	5,200
Do	Highland City Mills	5,370
Do	Talladega Cotton Factory	5,000
Do	Talladega Cordage Co	
Do	Talladega Hosiery Mills	
Childersburg, Ala	Childersburg Knitting Mills	
Total		255,398

Number of bales of cotton used in 1908, 224,200.

Cotton ginned in 1907, Coosa and Alabama River Valleys.

[Compiled by United States Engineer office, Montgomery, Ala.]

COOSA RIVER VALLEY.

State.	County.	Number of bales.	State.	County.	Number of bales.
Georgia	Whitfield	4,115	Alabama	St. Clair	5,724
Do	Gordon	10,111	Do	Talladega	20,843
Do	Bartow	17,669	Do	Shelby	7,319
Do	Floyd	14,027	Do	Coosa	9,775
Do	Chattooga	8,989	Do	Chilton	10,970
Do	Polk	10,559	Do	Elmore	22,232
Alabama	Cherokee	13,745			
Do	Etowah	10,567	Total		178,485
Do	Calhoun	11,840			

ALABAMA RIVER VALLEY.

State.	County.	Number of bales.	State.	County.	Number of bales.
Alabama	Autauga	12,291	Alabama	Monroe	24,021
Do	Montgomery	40,752	Do	Clarke (one-half)	9,771
Do	Lowndes	33,422			
Do	Dallas	39,908	Total		193,964
Do	Wilcox	33,799			

APPENDIX G.

LETTER OF INSPECTOR H. N. SULLIGER.

SUMMARY OF COMMERCIAL DEVELOPMENT.

MONTGOMERY, ALA., *May 9, 1909.*

SIR: I have the honor to submit to you the following report of my recent investigation of the resources of the Coosa River Valley and the shipment of commodities to and from its principal towns.

The statistical data is compiled under county headings and covers the territory tributary to the Coosa River in Alabama and Georgia. A tabulation of the manufacturing industries of each town is given, showing the capitalization, the amount and value of their annual production, and the general direction of their shipment to market.

Table 1 of the large sheets shows in tabulated form the movements of freight in the different towns of the Coosa River Valley and a summing up of their manufacturing industries.

Table 2 is a tabulation of statistical data of the counties of the valley, giving their resources as to agricultural production and manufactured products.

The production of foodstuff in this region is not sufficient to meet the demands of its inhabitants. Consequently there is a heavy import of grain, flour, hay, and meat from the Northwestern States and of general merchandise from the North and East; also most of the manufactured articles of common use are brought to this region.

The principal exports are cotton, cotton products, coal, marble, cement, lime, and heavy iron and steel articles, all of which are of considerable weight or bulk, requiring cheap transportation to market.

There is a large through traffic of freight from the Northern and Western States to the South Atlantic and Gulf States. This does not follow along the Coosa River, but crosses it from the northeast and from the northwest from Atlanta, Chattanooga, and Birmingham.

Due to the present industrial conditions, the production of coal and iron ore during the past year is about one-half that of former years, and many mills and factories are running on one-half to three-fourths time.

There is a great abundance of marble, coal, iron ore, and timber adjacent to the Coosa River, and these, together with the brick, cement, lime, and pig iron made in the valley, could be sent out in large quantities upon an open river.

The data covers the present and normal production of the mines and iron-ore furnaces. The tabulations, however, give the present production, with the exception of the Southern Steel Co., of Gadsden, which is included in the totals as operating.

Very respectfully,

H. N. Sulliger, *Inspector.*

Capt. H. B. Ferguson,
Corps of Engineers.

Statistical data upon the counties of the Coosa River Valley, Ala. and Ga. (1909).

	Counties.				
	Whitfield, Ga.	Gordon, Ga.	Barbour, Ga.	Polk, Ga.	Floyd, Ga.
1. County population in 1908	17,000	16,000	24,000	21,000	41,000
2. Increase in personal tax value, 1904–1908, per cent	40	45	56	23	27
3. Increase in realty tax value, 1904–1908..per cent..	18	38	36	18	33
4. Increase in total tax value, 1904–1908.......do....	29	42	46	20	30
5. Capital in manufacturing plants.........dollars..	1,200,000	260,000	1,350,000	4,250,000	4,700,000
6. Products of manufacturing plants..........tons..	45,200	10,000	66,250	62,000	109,000
7. Products of manufacturing plants.......dollars..	3,025,000	150,000	2,050,000	3,652,000	8,600,000
8. Capital in iron-ore furnaces...............do....				200,000	175,000
9. Products of iron-ore furnaces..............tons..				10,000	20,000
10. Products of iron-ore furnaces............dollars..				150,000	300,000
11. Capital in cotton mills.....................do....	945,000	150,000	750,000	1,775,000	2,600,000
12. Products of cotton mills...................tons..	5,100		2,250	7,070	13,400
13. Products of cotton mills.................dollars..	1,845,000		800,000	2,902,000	4,840,000
14. Spindles in cotton mills................number..	27,500	5,300	33,000	83,000	100,000
15. Cotton used in cotton mills...............bales..	19,500		10,000	29,000	55,000
16. Cotton raised in 1907.......................do....	4,115	10,111	17,669	10,559	14,027
17. Value of cotton crop in 1907 (lint).......dollars..	205,000	505,000	885,000	525,000	700,000
18. Corn, wheat, and oats raised in 1907.....bushels..	620,000	750,000	965,000	545,000	790,000
19. Value of grain crop in 1907..............dollars..	485,000	615,000	725,000	460,000	615,000
20. Timber cut per year.......................M feet..					
21. Value of timber cut.....................dollars..					
22. Iron ore mined.............................tons..			93,000	135,000	5,000
23. Bauxite ore mined.........................do....			1,000		8,000
24. Ocher ore mined...........................do....			7,000		
25. Black lead mined..........................do....			20,000		
26. Graphite..................................do....					
27. Lime and limestone........................do....			42,000		
28. Marble..............................cubic feet..					
29. Coal.......................................tons..					
30. Value of mineral products...............dollars..			288,000	238,000	80,000
31. Coke made..................................tons..					
32. Charcoal made.............................do....					16,200
33. Coal consumed.............................do....	25,000		37,000	82,000	87,000
34. Coke consumed.............................do....	1,500				25,000
35. Miles of railroad in county.....................	50	50	75	75	105

Statistical data upon the counties of the Coosa River Valley, Ala. and Ga. (1909)—Continued.

	Counties.				
	Chattooga, Ga.	Cherokee, Ala.	Etowah, Ala.	Calhoun, Ala.	St. Clair, Ala.
1. County population in 1908	14,500	22,000	32,000	40,000	22,000
2. Increase in personal tax value, 1904–1908, per cent	29	25	63	70	....
3. Increase in realty tax value, 1904–1908..per cent	36	9	43	98	....
4. Increase in total tax value, 1904–1908.......do	33	17	53	84	....
5. Capital in manufacturing plants.........dollars	780,000	250,000	6,436,000	7,304,000	2,150,000
6. Products of manufacturing plants..........tons	5,750	15,000	456,000	274,575	28,000
7. Products of manufacturing plants.......dollars	1,550,000	180,000	12,670,000	10,283,000	1,190,000
8. Capital in iron-ore furnaces..............do	....	250,000	2,125,000	2,000,000	....
9. Products of iron-ore furnaces..............tons	....	15,000	84,000	85,000	....
10. Products of iron-ore furnaces............dollars	....	225,000	1,260,000	1,275,000	....
11. Capital in cotton mills....................do	750,000	....	1,200,000	3,050,000	978,000
12. Products of cotton mills.................tons	3,750	....	5,250	6,450	2,275
13. Products of cotton mills...............dollars	1,500,000	....	2,200,000	2,890,000	967,000
14. Spindles in cotton mills...............number	57,300	....	63,000	113,700	22,000
15. Cotton used in cotton mills...............bales	17,000	....	24,000	30,400	14,000
16. Cotton raised in 1907.......................do	8,989	13,745	10,567	11,840	5,724
17. Value of cotton crop in 1907 (lint).......dollars	450,000	685,000	530,000	590,000	286,200
18. Corn, wheat, and oats raised in 1907....bushels	535,000	910,000	730,000	730,000	735,000
19. Value of grain crop in 1907..............dollars	840,000	700,000	550,000	560,000	565,000
20. Timber cut per year.....................M feet	....	....	....	....	....
21. Value of timber cut....................dollars	....	....	....	....	....
22. Iron ore mined...........................tons	....	76,000	196,000	20,000	....
23. Bauxite ore mined........................do	....	6,000	....	....	....
24. Ocher ore mined..........................do	....	....	....	....	....
25. Black lead mined.........................do	....	....	....	....	....
26. Graphite mined...........................do	....	....	....	....	....
27. Lime and limestone.......................do	....	....	361,000	....	....
28. Marble...............................cubic feet	....	....	....	....	....
29. Coal.....................................tons	....	....	112,000	....	105,000
30. Value of mineral products..............dollars	....	190,000	785,000	35,000	150,000
31. Coke made................................tons	....	....	....	....	....
32. Charcoal made............................do	....	....	4,000	....	....
33. Coal consumed............................do	18,000	6,000	70,000	120,000	20,000
34. Coke consumed............................do	....	....	330,000	200,000	....
35. Miles of railroad in county	45	65	115	140	115

	Counties.					Total, 15 counties.
	Talladega, Ala.	Shelby, Ala.	Coosa, Ala.	Chilton, Ala.	Elmore, Ala.	
1. County population in 1908	38,000	26,000	17,000	20,000	28,000	378,500
2. Increase in personal tax value, 1904–1908..........per cent	25	41	....	32	40	40
3. Increase in realty tax value, 1904–1908..........per cent	43	33	....	53	18	88
4. Increase in total tax value, 1904–1908, per cent	34	38	....	43	29	38
5. Capital in manufacturing plants, dollars	6,072,000	1,025,000	....	....	160,000	35,937,000
6. Products of manufacturing plants, tons	170,000	26,000	....	....	13,000	1,280,200
7. Products of manufacturing plants, dollars	3,945,000	400,000	....	....	170,000	47,865,000
8. Capital in iron-ore furnaces...dollars	3,604,000	1,000,000	....	....	....	9,354,000
9. Products of iron-ore furnaces....tons	93,500	24,000	....	....	....	331,500
10. Products of iron-ore furnaces..dollars	1,145,000	860,000	....	....	....	4,972,500
11. Capital in cotton mills..........do	1,495,000	....	....	....	120,000	13,813,000
12. Products of cotton mills.........tons	5,435	....	....	....	400	51,380
13. Products of cotton mills......dollars	1,935,000	....	....	....	135,000	20,014,000
14. Spindles in cotton mills......number	69,100	....	....	....	6,300	580,000
15. Cotton used in cotton mills.....bales	23,500	....	....	....	1,800	224,200
16. Cotton raised in 1907............do	20,843	7,319	9,775	10,970	22,232	178,485
17. Value of cotton crop in 1907 (lint), dollars	1,040,000	365,000	490,000	550,000	1,110,000	8,924,250
18. Corn, wheat, and oats raised in 1907, bushels	925,000	645,000	615,000	490,000	680,000	10,667,000
19. Value of grain crop in 1907....dollars	710,000	490,000	460,000	370,000	510,000	8,625,000
20. Timber cut per year...........M feet	....	....	....	....	....	....
21. Value of timber cut...........dollars	....	....	....	....	....	....

Statistical data upon the counties of the Coosa River Valley, Ala. and Ga. (1909)—Continued.

	Counties.					Total, 15 counties.
	Talladega, Ala.	Shelby, Ala.	Coosa, Ala.	Chilton, Ala.	Elmore, Ala.	
22. Iron ore mined.....tons..	230,000	24,000		11,000		[1] 790,700
23. Bauxite ore mined.....do....						[2] 15,000
24. Ocher ore mined.....do....						[3] 7,000
25. Black lead mined.....do....						[4] 20,000
26. Graphite mined.....do....				175		175
27. Lime and limestone.....do....		50,000				453,000
28. Marble.....cubic feet..						
29. Coal.....tons..						[5] 217,000
30. Value of mineral products.....dollars..	410,000	385,000		25,000		2,586,000
31. Coke made.....tons..						
32. Charcoal made.....do....	2,500					25,000
33. Coal consumed.....do....	63,000	11,000		2,000	6,000	550,000
34. Coke consumed.....do....	185,000					740,000
35. Miles of railroad in county.....	175	140	14	65	26	1,255

[1] $1.75 per ton. [2] $9 per ton. [3] $12 per ton. [4] $3 per ton. [5] $1.50 per ton.

Appendix H.

Freight movement and present railroad rates of the Coosa River Valley.

[Compiled by United States Engineer office, Montgomery, Ala.]

Article.	Remarks.
Grain, hay, flour, and meal....	Brought in from the North and West, large bulk.
Fertilizer material..........	Brought in from South America, Germany, and Florida.
Sugar and coffee..........	Brought in from Louisiana, South and Central America.
HEAVY PRODUCTS.	
Iron ore..........	Sent to furnaces in the South.
Pig iron..........	Sent to furnaces all over United States.
Cast-iron pipe..........	Sent all over United States.
Iron and steel products..........	Do.
Coal..........	Sent to Southeastern States.
Coke..........	Sent to furnaces and foundries in the South.
Ocher ore..........	Sent North and export.
Black lead..........	Sent to fertilizer mixing works in the South.
Bauxite ore..........	Sent to North Atlantic States.
Manganese ore..........	Do.
Lime and limestone..........	Sent to furnaces and Southeastern States.
Slate..........	Sent to Southern States.
Cement..........	Do.
Brick..........	Do.
Cotton..........	Sent to Northeastern States and export.
Cotton goods..........	Sent to United States and export.
Cottonseed oil, etc..........	Do.
Marble..........	Do.
Lumber..........	Do.

TABLE No. 1.—*Railroad freight rates.*

[Compiled by United States Engineer office, Montgomery, Ala.]

Class of freight.	From—	To— Mobile, Ala.	New Orleans, La.	Savannah, Ga.	San Francisco, Cal.	Montgomery, Ala.	Selma, Ala.	Anniston, Ala.	Rome, Ga.	Talladega, Ala.	Cartersville, Ga.
Iron (per ton)	Rome, Ga	$2.75									
	Gadsden, Ala	2.50									
	Anniston, Ala	2.25		$2.75							
Marble (per hundredweight).	Alabama quarries	.13	$0.14								
Cement (per barrel 400 pounds).	Rockmart, Ga	.46									
	Penn Mills		.20								
Common brick (per 1,000).	Rome, Ga	4.75		4.00							
Paving brick (per 1,000).	Ragland, Ala	6.30				$6.50	$5.00				
Cotton (per hundredweight).	Rome, Ga	.21		.45							
	Anniston, Ala	.43		.45							
	Talladega, Ala	.30		.45							
Cotton goods (per hundredweight).	Rome, Ga	.40		.49							
	Anniston, Ala	.40		.49							
	Talladega, Ala	.32	.80	.53	$2.40						
	Cedartown, Ga				2.25						
Coal (per ton)	Ragland, Ala	1.80				1.48	1.48				$1.05
	Piper, Ala	1.10				1.00	1.00				
	Altoona, Ala	1.10				1.00	1.00				
Fertilizer material (per ton).	Pensacola, Fla							$2.15		$2.05	
	Mobile, Ala							2.55	$2.70	2.15	

Iron ore (per ton):
- Cartersville, Ga., to Gadsden, Ala $0.65
- Cedartown, Ga., to Gadsden, Ala .... .37
- Cedartown, Ga., to Rome, Ga .... .55
- Cave Spring, Ga., to Rock Run, Ga .... .12½

TABLE No. 2.—*Results of observations on bars in Alabama River, Ala.*

Date.	Gauge readings in feet. At gauge station (in pools).		On bar.		Discharge, cubic feet per second.	On bar. Mean velocity.	Slope of water surface.	Area of cross-section.	Mean depth.	Value of coefficient.	Coefficient of roughness.
1908. Nov. 4	Wetumpka	4.0	Below cut-off	4.0	9,539	3.65	1:2,200				
6	do	4.3	do	4.3	9,711	3.64	1:2,200	2,500	6.4		
7	do	3.3	do	3.4	7,863	3.68	1:2,200	2,053	5.3		
9	do	2.6	do	2.7	6,869	3.43	1:2,200	1,800	4.6		
9	do	2.6	Mouth Tallapoosa	2.6	6,869	3.65	1:1.233				
11	do	2.3	Below cut-off	2.5	5,863	3.24	1:2,200	1,703	4.4	72.449	0.0265
12	do	2.1	do	2.3	5,429	3.82	1:2,200				
21	do	1.6	do	1.9	4,763	3.02	1:2,200				
Oct. 23	Montgomery	−0.1	Below Montgomery.	−0.1	4,232		1:2,000				
22	do	0.0	do	0.0	4,350	2.72	1:2,000	1,568	3.7	63.239	.0294
Nov. 9	do	1.1	do	1.1	6,286		1:2,000				
4	do	1.9	do	1.9	8,576		1:2,000	2,474	4.5		
6	do	3.2	do	3.2	11,645		1:2,000				
5	do	3.9	do	3.9	14,026		1:2,000				
Oct. 31	Selma	−0.5			5,093	1.34	1:5,800				
Nov. 2	do	−0.3			5,158	1.32	1:5,800				
3	do	+0.1			5,976	1.46	1:5,800	2,460	5.9		
4	do	0.3½			6,545	1.58	1:5,800	2,527	6.0		
5	do	1.2½			8,180	1.81	1:5,800				
6	do	3.8			14,404	2.53	1:5,800				
7	do	3.7	Below Selma	3.5	12,827	2.29 2.83	1:5,272				
9	do	1.6	do	1.5	8,706	1.84	1:3,867	3,060	7.1		
10	do	1.0	do	1.0	7,689	1.72 2.52	1:5,800				
11			do	1.1		2.71	1:5,800	2,984	7.0		
12	Selma	0.9	do	1.0	7,385	2.47	1:5,800	2,915	6.9	71.612	.0300

TABLE No. 3.—*Alabama River, Ala.—Computed velocities and widths of channel for depth and slope given.*

Depth in feet.	Velocity in second-feet.	Slope 1: 5,000. Width in feet for discharge shown.										
		2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000
4	1.8	281	421	561	701	841	......	......	......	......	......	......
5	2.1	192	287	383	479	575	671	767	862	......	......	......
6	2.4	......	210	279	349	418	488	558	628	698	767	......
7	2.7	......	161	215	269	323	376	430	484	538	592	645
8	2.9	......	......	171	214	257	300	342	385	428	472	514
9	3.1	......	......	......	176	211	246	281	316	352	387	422
10	3.4	......	......	......	......	177	206	235	265	294	324	353

Depth in feet.	Velocity in second-feet.	Slope 1: 2,000. Width in feet for discharge shown.										
		2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000
4	2.8	177	266	350	444	532	621	710	......	......	......	......
5	3.3	121	182	242	303	364	424	485	545	606	667	727
6	3.7	......	134	179	224	268	313	358	403	447	492	537
7	4.1	......	......	138	172	207	241	276	310	345	379	414
8	4.5	......	......	......	138	165	193	220	249	276	304	331
9	4.9	......	......	......	......	136	158	182	204	227	246	272
10	5.2	......	......	......	......	......	134	153	172	191	210	229

SURVEY OF ETOWAH, COOSA, AND TALLAPOOSA RIVERS, GA. AND ALA.

UNITED STATES ENGINEER OFFICE,
Montgomery, Ala., June 10, 1910.

SIR: I have the honor to submit the following report of survey and estimates for the Etowah, Coosa, Tallapoosa, and Alabama Rivers, as provided for in the river and harbor act approved March 3, 1909:

Etowah, Coosa, and Tallapoosa Rivers, with a view to their improvement for navigation. Such examination for the improvement of the navigation of said rivers, including the Alabama River in connection therewith, shall include investigations necessary to determine whether storage reservoirs at the headwaters of said rivers can be utilized to advantage, and if so, what portion of the cost of any such improvements, including reservoirs, should be borne by owners of water powers and others.

EXTENT OF SURVEYS.

Surveys have been made of one reservoir site on the Etowah River, of one reservoir site on the Conasauga River, and of two reservoir sites on the Tallapoosa River. Detail surveys and borings have been made at various lock and dam sites on the Coosa River.

GENERAL DESCRIPTION AND PLAN.

The Coosa River is formed by the junction of the Etowah and Oostenaula Rivers at Rome, Ga. The Coosa River and the Tallapoosa River form the Alabama River. Reference is made to general map No. 1 of the preliminary report. The Coosa River is now navigable, during ordinary low water, from Rome, Ga., to Lock No. 4, Alabama, a distance of 182 miles; from Lock No. 4 to Wetumpka, a distance of 116 miles, it is not navigable; from Wetumpka to the Gulf, a distance of 323 miles, the Coosa-Alabama River is navigable. The present project on the lower river is for 4-foot navigation from Montgomery to the Gulf.

The general plan herein proposed is for locks and dams on the Coosa River, for storage reservoirs on the headwaters of the Coosa and on the Tallapoosa Rivers, and for regulation on the Alabama River. The instructions call for report on the possibilities of coordination of water-power and navigation interests and the relative costs that should be borne by each interest.

RESERVOIRS.

4. Reservoirs will each be considered under the following subheads: (*a*) Available storage, (*b*) reservoir capacity and cost, (*c*) effective storage, (*d*) effect on navigation, (*e*) effect on water power.

ETOWAH RESERVOIR.

The reservoir site recommended is the one referred to in the preliminary report, being just below the mouth of Allatoona Creek, about 3 miles east of Cartersville, Ga.

(*a*) *Available storage.*—Table No. 4 gives the run-off of the Coosa River watershed above Rome for all the years of record, this table being compiled from the Geological Survey records. The run-off at the reservoir site is computed from records of 1897–1908 to be 2.23 cubic feet per square mile, which estimate is on the safe side. The records of Canton for 7 years give the mean annual run-off as 2.52. The mean annual run-off of the Etowah River at Rome is 1.82. The run-off between Canton and the proposed dam site is taken to be the same as the run-off at Rome. This mean run-off gives a flow of 2,280 cubic feet per second, which equals 69,000,000,000 cubic feet. The mean flow for 1903 is estimated as 2,560 second-feet.

The annual rainfall and run-off and the difference between the two, or the losses for various rivers in this vicinity for the years of run-off records, are given in Table No. 5. The annual rainfall record for a somewhat more extended section from 1856 to date is given in Table No. 5*a*. The rainfall, run-off, and temperature by the month for the watershed above Selma, for the years 1897–1907, inclusive, are shown on drawing No. 3; the daily rainfall, run-off, and temperature for 1897 and 1904, which years are the two of lowest low water of record, are shown on drawings Nos. 4 and 5.

(*b*) *Reservoir capacity and cost.*—The capacity of this reservoir with a dam which will raise the water surface 174 feet is 42,000,000,000 cubic feet, which is equal to about 60 per cent of the mean annual run-off. The silting of the reservoir will, it is believed, be inconsiderable. The Etowah Reservoir site is so far below the steep portions of the upper river that the rolling material will be dropped before reaching it. The amount of suspended matter in the Coosa River was measured and found to be negligible. Reference is made to the preliminary report.

The estimated cost of dam and flooded lands is $4,000,000, or $95 per million cubic feet. The foundation and abutments for the dam are good, being gneiss and granite. The location provides a spillway 2,600 feet north of dam separated therefrom by a rock knoll. Full details are given in Table No. 8 and in report of Mr. D. M. Andrews, assistant engineer. (Appendix J.)

(c) *Effective storage.*—The amount of water that will actually reach the power dams and navigable river, when needed, will be called the effective storage which, for a given year, must be the same as the storage required or the annual shortage below a certain flow. This shortage has been computed for the critical periods or years of extreme low water in this vicinity, and is plotted for Selma, Montgomery, and Riverside on drawings Nos. 6, 7, and 8. The effective storage will be the reservoir capacity less the losses and plus the additions enumerated below. One loss will be evaporation from the reservoir surface; another will be the increase of evaporation on the river due to the increased water surface resulting from the increased low-water flow and from the dams on the Coosa River. Both of these losses and the method of their computation are given in Table No. 6. There will be another loss, due to errors of control. This loss will occur when water has been turned loose at the reservoir to supply the amount needed at a certain predicted stage of the river, which stage may not be reached, owing to rain, before the reservoir supply can arrive at the portion of river to be affected, the result being that more water was supplied to the river than necessary. The period of prediction at the upper power dam is about two days. Local storage at the power dams, which provide for daily fluctuations, can largely eliminate one day's error of prediction. To diminish this loss on the Alabama River 1 foot draw off, regulated by the Government for navigation, is allowed at each power dam. With the above provisions the amount still lost is, to a certain extent, indeterminate, and, to make the calculations safe, has been assumed at about 10 per cent.

No loss for seepage from the reservoir basin is estimated, as the geological formation is granite and gneiss overlaid with varying depths of clay.

An addition that must be made is the water that would have been caught during the critical period. Figured on the above basis, the effective storage for the year 1904 would have been 37.7 billion cubic feet. This is shown by the figures in Table No. 6.

There will be at the power dams on the Coosa River a total storage aggregating 3.4 billion cubic feet, which storage is the amount held by the dams after deduction is made for the daily pondage necessary for 10-hour power. It is estimated that these ponds will be drawn down for this storage twice during such a year as 1904, which gives 6.8 effective storage, if used in conjunction with the Etowah storage. As a matter of record the Coosa storage could have been drawn down and caught again four times during 1904.

The results obtained from the total storage, or the storage effective at a certain point (Riverside power, or Montgomery navigation) will depend on the method of control or regulation. If regulated for either Riverside or Montgomery alone the effects in each case are seen in drawings Nos. 7 and 8, respectively.

Drawing No. 9 shows the daily shortage at Riverside on the Coosa River and drawing No. 10 at Montgomery on the Alabama River. These curves combined would show what will be called the difference in phase of the shortage. With the 30 billion shortage lines on these two drawings in coincidence, the difference in phase shown by the area between the curves is 7.7 billion cubic feet; that is, to get the effect at each place due to 30 billion regulated for that place alone, it would be necessary to have a storage of 30 billion plus 7.7 billion, or 37.7 billion cubic feet. The storage on the Coosa River is practically equal to this difference in phase of shortage; therefore the Etowah Reservoir could be regulated for navigation alone, giving 37.7 billion cubic feet effective storage therefor, and the storage at the power dams of the Coosa could be used for power alone. A combination of these methods of regulation will be most economical.

Table A below gives the storage effective at each power dam and at Montgomery, all storage being controlled for both power and navigation.

TABLE A.—*Effective storage due to Etowah Reservoir and to local storage at power dams on the Coosa River.*

	Number of dam.		Storage (billion cubic feet).		
				1904	
	1910 report.	1905 report.	Reservoir capacity.	Effective storage.	Total effective at locality.
Etowah Reservoir			40.3	30.0	30.0
Coosa River	2	2	1.15	2.3	32.3
	6	7	.00	.0	32.3
	10	12	1.65	3.3	35.6
	11	14	.00	.0	35.6
	12	15	.20	.4	36.0
	13	18	.40	.8	36.8
Alabama River at Montgomery			.00	6.8	36.8

(*d*) *Effect on navigation.*—On the upper Coosa River the low-water flow in 1904 was about 800 second-feet. Thirty billion cubic feet effective storage will increase this low-water flow to about 3,600 second-feet (see drawing No. 8), which flow will, with regulation, give 4 or 6 foot navigation, depending on amount of channel improvement between Rome and Lock No. 1, except at Horseleg Shoals, where the abrupt slope requires the construction of a lock, for which appropriation has been made.

The years of extreme low water to be considered are 1897 and 1904. Drawing No. 6 gives the shortage below a certain flow or the storage required to maintain a certain minimum flow for these two years and others at Selma. It is noted that up to a flow of about 6,000 second-feet the 1897 shortage is greater. The rainfall in 1897 was 44.79 inches; the total shortage below 4,000 second-feet was 4.62 billion cubic feet. The total rainfall in 1904 was 38.99 inches; the total shortage below 4,000 second-feet was 2.32 billion cubic feet. For any flow above 6,000 second-feet the 1904 shortage is greater. The year 1904 is taken as the critical year.

The Alabama River in 1904 had a minimum low-water flow of about 2,100 second-feet at Montgomery and 3,300 second-feet at Selma. Thirty-six and eight-tenths billion cubic feet effective storage will increase this minimum flow to 6,600 and 7,700 second-feet, respectively (as seen on drawings Nos. 6 and 7), which increase will raise the Montgomery gauge height from -1.9 to $+0.8$ without any regulation.

The present regulation contemplates 4-foot navigation with the gauge at zero. At extreme low water, such as in 1904, it is not practicable to maintain 4-foot navigation on this river without very expensive regulation. With 6,600 second-feet flow, 4-foot navigation can be secured with very moderate regulation; less than would be required under the present project, which would give 4.8-foot navigation with above flow. To obtain 6-foot navigation with 6,600 second-foot flow, regulation in excess of the present project will be necessary; 1.2 feet additional depth must be obtained. This regulation will require a channel width of about 350 feet near Montgomery and about 400 feet below Selma. This amount of regulation is practicable and is a question of cost which can not be definitely estimated, but will exceed that of the present project ($500,000).

What might be termed the natural width of the Alabama River is about 450 feet at Montgomery and about 500 feet at Selma. From Wetumpka to the mouth of the Alabama River, at its junction with the Tombigbee to form the Mobile River, the distance is 323 miles. The fall is 115 feet from Wetumpka to the Gulf. The slope in the natural pools of the river is computed to be about 1 foot in 7 miles. If the total length of pools is taken as 250 miles, the fall therein will be 35 feet, leaving a fall of 80 feet that will require contraction and regulating works. If the slope is made 1 in 5,000, this 80-foot fall will require contraction works for approximately 75 miles. If the slope is made 1 in 2,000, contraction works will be required for about 30 miles. The contraction works will vary between these two slopes, depending on local conditions and the economic method at a special locality.

(*e*) *Effect on water power.*—The low-water flow at Riverside in 1904 was 1,225 cubic feet per second. The increase of low-water flow at Riverside due to storage may be seen on drawing No. 8. With the storage proposed, the low-water flow at any power dam will be made up of three parts: (1) The natural low-water flow; (2) the increase due to the storage effective at the dam, this increase being the same as that at Riverside, shown on drawing No. 8; and (3) the run-off from the watershed between Riverside and the power dam. This last increment is not the run-off during extreme low water, at which times, as seen on drawings Nos. 9 and 10, the Montgomery shortage exceeds the Riverside shortage and the navigation storage more than supplies the power shortage. The run-off when the Riverside shortage exceeds the Montgomery shortage is therefore taken. Such condition occurs only when there is a rise in the Tallapoosa River, or there is a heavy rain between Montgomery and Riverside, at which times (e. g., July, 1904, drawings Nos. 9 and 10) the flow at Riverside is taken as about 2,200 second-feet, which flow requires practically twice the extreme low-water run-off. On this basis the flow and power at the various power-dam sites is computed to be according to Tables "B" and "C."

The dams that are called power dams are at those sites where it is believed power can be profitably developed at this time, or at those sites that would probably be developed for power alone were this not a navigable river. Such sites are dams that in report of 1905 are numbered 2, 7, 12, 14, 15, and 18. The new numbers, according to the project herein proposed, will become 2, 6, 10, 11, 12, and 13, respectively.

TABLE B.—*Flow at power dams on Coosa River.*

Number of dam.		Flow in second-feet, 1904 low water, less lockage and leakage.		
		I.	II.	III.
1910 report.	1905 report.	Without storage.	Local storage (cumulative).	Local and Etowah reservoir storage (cumulative).
2	2	1,063	1,563	3,970
6	7	1,173	1,673	4,164
10	12	1,313	2,113	4,747
11	14	1,338	2,138	4,800
12	15	1,432	2,287	5,051
13	18	1,415	2,360	5,120

TABLE C.—*Horsepower on Coosa River.*

Number of dam.		Power head.	Efficiency.	Cumulative local storage, 1904.		Cumulative local and Etowah storage.	Increase on account of Etowah storage.	
				I.	II.	III.	IV.	V.
1910 report.	1905 report.			Primary, 10-hour, delivered.	Secondary, 10-hour, delivered.	Primary, 10-hour, delivered.	Secondary made primary, 10-hour, delivered.	Additional primary, 10-hour, delivered.
		Feet.	*Per cent.*					
2	2	26	50	6,650	6,650	16,891	6,650	3,591
6	7	29	60	7,939	7,939	19,760	7,939	3,882
10	12	63	64	23,235	23,235	52,200	23,235	5,730
11	14	50	62	18,076	18,076	40,582	18,076	4,430
12	15	42	63	16,503	16,503	36,450	16,503	3,444
13	18	63	64	25,951	25,951	56,302	25,951	4,400
Total				98,354	98,354	222,185	98,354	25,477

In above Table B, Column II, the flow at each dam site is taken to be that due to the natural flow of the river plus accumulative storage from the various power dams above. This condition depends, of course, on the prior construction of all dams above a given dam.

In above Table C the amount of primary power is based on the lowest low-water record. The amount of secondary power is taken as equal to the primary power. This secondary power will be available for about 90 per cent of the time. This allowance of secondary power is within what might be called good practice.

From the above table it is seen that with Etowah storage, all the secondary power becomes primary power, and in addition there is created 25,477 horsepower which will also be primary power. While the table has been made on the basis that installation without Etowah storage would only be made for secondary power equal to the primary, with the possibility of this Etowah storage the installation would no doubt be made for 123,834 secondary power.

CONASAUGA RESERVOIR.

(*a*) *Available storage.*—There is no gauging station on this river near the dam site, which site is just below the mouth of Jack River.

The run-off is estimated by comparison with the Coosawattee River at Carters, the character of the two watersheds being similar. On this basis, the mean annual run-off is estimated to be 6.9 billion cubic feet. The run-off for the year 1903, or the year before the extreme low water of 1904, is estimated as 8,000,000,000 cubic feet. Gauge readings should be continued at this site to determine more accurately the run-off, which factor in this case governs the possible storage. No work is recommended at this place until this run-off is more accurately ascertained.

(*b*) *Reservoir capacity and cost.*—With a dam 160 feet high, the estimated capacity is 6,000,000,000 cubic feet. The estimated cost of this dam and the flooded lands is $1,150,000, or $191.67 per million cubic feet of storage.

(*c*) *Effective storage.*—The effective storage is estimated as 4,000,000,000 cubic feet. The losses due to errors of control and to evaporation are taken as 2,000,000,000 cubic feet.

(*d*) *Effect on navigation.*—If this reservoir alone is built, the 4,000,000,000 effective storage, with the control proposed, will increase the minimum flow of the upper Coosa River from about 800 to about 1,600 second-feet, and of the Alabama River at Montgomery from 2,100 to about 2,900 second-feet for such a year as 1904. This 4,000,000,000 cubic feet added to 30,000,000,000 cubic feet Etowah storage will increase the Montgomery minimum flow about 400 second-feet—from 6,600 to about 7,000; if added to the Etowah and Tallapoosa storage, which must be used over a more extended period, it will increase the Montgomery flow about 250 second-feet, as will be seen from the curves on drawing No. 7.

(*e*) *Effect on water power.*—In similar manner this storage alone will increase the low-water flow at Riverside from 1,225 to about 2,150, or by about 900 second-feet. If added to the 4.1 billion cubic feet of local storage on the Coosa River (this local storage alone is 4.1 billion; with Etowah it is 3.4, the difference being due to the increased pondage necessary for 10-hour power with Etowah storage), it will increase the flow about 450 second-feet. Added to the Etowah storage, it increases Riverside flow about 200 second-feet. The total power head on the Coosa River is about 270 feet. An increase of 100 second-feet increases the power by about 2,000 horsepower (24-hour) delivered, the delivered horsepower being figured as 64 per cent of the theoretical horsepower.

COST OF LOCKS, DAMS, AND POWER ON COOSA RIVER.

Estimates have been prepared as follows: Six-foot navigation, 9-foot navigation, and for navigation and power, with local storage at power dams and with Etowah reservoir storage.

The first estimate is based on the project proposed in report of 1905. the changes being that Dams Nos. 2 and 7 are raised, eliminating Locks and Dams Nos. 1 and 6. The additional first cost is $88,000; the saving in maintenance and operation is estimated at $10,000 per year.

Estimates for 9-foot navigation were made because of the fact that with the high dams required and the local storage obtained, Dams Nos. 2, 12, 15, and 18 (1905 Nos.) will afford local storage, or a 9-foot navigation, or a 9-foot navigation during part of the time and a 6-foot navigation during such times as the storage is drawn off. With all the storage that it is possible to obtain, a flow can be had on the Alabama River with which it is believed, with maximum regulation, it will be possible to obtain 9-foot navigation. The additional cost of obtaining this 9-foot navigation at the higher dams, if it is obtained now, is small compared to the cost of making the change later.

In the third estimate the locks and dams numbered 3, 4, 5, 8, 9, 10, and 20 in Maj. Cavanaugh's report (1905) are unchanged, the changes from this report being that Dam No. 2 is raised, eliminating Dam No. 1; Dam No. 7 is raised, eliminating Dam No. 6; Dam No. 12 is raised, eliminating Dam No. 11; Dam No. 14 is moved upstream and raised, eliminating Dam No. 13; Dam No. 18 is raised, eliminating Dams Nos. 16 and 17; Dam No. 19 is raised to make an equalizing reservoir.

Table D below gives the estimate for 6-foot and for 9-foot navigation. The details of these various estimates are given in report of Mr. D. M. Andrews, assistant engineer, in Appendix J.

TABLE D.—*Navigation.*

Locks. (Old numbers given in 1905 report.)	I. 6-foot; 18 dams.	II. 6-foot; estimates affected by construction of dams providing for navigation and power—Table E.	III. 9-foot; 18 dams.	IV. 9-foot; estimates affected by construction of dams providing for navigation and power—Table E.
1.				
2.	$402,000	$402,000	$456,000	$456,000
3.	420,000	....	554,000	....
4.	542,000	....	608,000	....
5.	286,000	....	332,000	....
6.				
7.	813,000	813,000	883,000	883,000
8.	294,000	....	337,000	....
9.	387,000	....	415,000	....
10.	498,000	....	547,000	....
11.	582,000		639,000	
12.	1,055,000	1,637,000	1,118,000	1,757,000
13.	932,000		995,000	
14.	726,000	[1] 1,415,000	779,000	[1] 1,514,000
15.	923,000	[2] 1,165,000	976,000	[2] 1,236,000
16.	629,000		688,000	
17.	505,000	1,582,000	550,000	1,725,000
18.	448,000		487,000	
19.	566,000	....	607,000	....
20.	105,000	....	123,000	....
Total	10,113,000	7,014,000	11,094,000	7,571,000
Etowah Reservoir	4,000,000	....	4,000,000	....
Grand total	14,113,000	7,014,000	15,094,000	7,571,000

[1] All of No. 13 and two-thirds of No. 14, Columns I and III.
[2] All of No. 15 and one-third of No. 14, Columns I and III.

The estimated cost of maintenance and operation is $10,000 per year for Etowah Reservoir, and $5,000 per year for each dam and lock.

Table E below gives the estimate for the coordinate development. It is desirable that the actual physical work be divided as clearly as possible. In Column IV of this table is given, for the dam, the estimated expenditure necessary for navigation at each site. This amount was obtained by subtracting the cost of the lock, channel excavation, etc., at the particular site (Column I) from the total cost of improving the stretch of river pertaining to this site (Column II or Column IV of Table D), and to this result was added the capitalized difference of maintenance and operation with the 14 dams of this table and the 18 dams of Table D.

In comparing these two plans, considering the benefits to navigation only, the coordinate plan (14 dams) is credited only with actual money saving due to lessened maintenance and operation. The benefits due to longer pools are important, although their money value can not be definitely determined.

In order that power at Dam No. 13 (1905, No. 18) may be used as 10-hour power (or less than 24-hour power), and that navigation may also receive constant flow, or the full benefit of storage, an equalizing dam is provided by raising Dam No. 14 (1905, No. 19) 10 feet. The cost of this addition to Dam No. 14 is $220,000, and this amount is deducted from the proper Government expenditure at Dam No. 13. To avoid complications it is recommended that the United States build this equalizing dam. It is considered that at some future time it will be possible to utilize the power at Dam No. 14 (1905, No. 19) if the same is used in conjunction with Dam No. 13 (1905, No. 18). Dam No. 13 has surplus power in high water when Dam No. 14 is drowned out. The power installation at Dam No. 14 will require a power house on the bank beyond the limits of dam proposed. No provision for same need be made in building the dam.

Table E.—*Navigation and power.*

Number of dam.		I.	II.	III.	IV.
1910 report.	1905 report.	Navigation only; locks, channel excavation, etc.	Common to navigation and power; high dams (including substructure of power house), flooded lands, etc.	Power only; superstructure of power house, installation, etc.	Navigation share of Column II.
2	2	$283,000	$438,000	....	$173,000
6	7	409,000	470,000	....	404,000
10	12	837,000	1,527,000	....	1,053,000
11	14	805,000	928,000	....	743,000
12	15	646,000	768,000	(1)	557,000
13	18	942,000	1,622,000	....	863,000
3	3				
4	4				
5	5				
7	8	3,068,000	....	....	....
8	9				
9	10				
14	19				
15	20				
14E	19E	....	....	....	220,000
Total.........		6,990,000	5,753,000	$7,794,000	4,013,000
Etowah Reservoir............		....	4,000,000	....	4,000,000
Grand total..		6,990,000	9,753,000	7,794,000	8,013,000

[1] Substructures are placed in Column II; transmission are lines not included.

The total estimated cost for navigation, being the sum of columns I and IV, is $15,003,000. The total estimate for the coordinate development is $24,797,000. The estimated cost of maintenance and operation is $10,000 per year for Etowah Reservoir, $5,000 for each single lock, $6,000 for each flight of two locks; the high dams to be operated and maintained by power companies.

PLAN OF COOPERATION.

Basis.—In the plan of cooperation it has been attempted to make conditions, from the point of view of the power companies, practically the same as if the river were not navigable.

It is not thought that the General Government acquires any right whatsoever in the power of the natural river development at any particular site unless it makes an expenditure at that site for a portion, or for all, of the dam. If the United States builds a dam for navigation purposes, the rights of private parties to utilize the resulting power are subject to the prior rights of navigation and to the payment of such charge as will be a fair and just recompense for the expenditure which has been saved them by the Government's structure.

The total power obtainable is estimated at 222,000 horsepower (10-hour), all absolute primary power. The sale of this amount of power will require time and will, in part, depend on the construction of factories of various sorts. The cost of a dam is chargeable against all the power that can be developed at the site, and becomes a profitable power investment only when the full power obtainable is sold. The costs of the water wheel and electric installations are practically proportional to the actual power developed. If one power dam only is built, it is of no benefit to navigation until all the dams are built. It is therefore desirable from a navigation point of view that proper encouragement be given to the building of all the dams.

Natural River.—It is recommended that appropriations be made for construction of the low dams and all the locks and that continuing contracts be authorized by Congress with the owner or owners of land along the river at each power site, to construct the dams at the respective power sites for the amounts given in Column IV in Table E (except Dam No. 6 (1905 No. 7), where a lower bid can perhaps be obtained) as the Government share of cost of said dam, and that the terms as to time of completion and the right to utilize the power due to said dam or to any reservoir built by the United States for a specified rental, and such other provisions as may be deemed proper be incorporated in the contracts.

It should be provided that the dam shall be 30 per cent constructed within three years and wholly completed within five years, and in case of failure to make such specified progress the United States shall have the right to complete said dam. In case of failure of any owner of land along the river at any dam site to make above-mentioned contract within two years, or in case of failure to make specified progress in construction of dam, it is recommended that the United States construct or complete such dam and that the power be disposed of as Congress may deem proper.

The rental specified in the contract on the power due to the natural river should finally be equivalent to commercial interest on the expenditure saved by power companies by the Government expenditure on the dams in Coosa River. The power of the natural river is estimated to be 98,000 horsepower, 10-hour primary power, and about the same amount of secondary power. To avoid complications when, with storage, the secondary power becomes primary, the rental should be based on primary power. Rental should for a reasonable time be based on power sold, as only such power has an actual value. Initial sale of power must usually provide for cost of changing from steam to electric installation; the initial rental should therefore be made low.

If the Government expenditure at each dam is made the amount (in Table E, Column IV) chargeable to navigation and 6 per cent is assumed as proper commercial interest, the final rental per year per 10-hour horsepower for primary power obtainable (as given in Table C, Column I) would be as follows: Lock No. 2. $1.60; Lock No. 6, (1905 No. 7), $3.05; Lock No. 10 (1905 No. 12), $2.72; Lock No. 11 (1905 No. 14), $2.47; Lock No. 12 (1905 No. 15), $2; Lock No. 13 (1905 No. 18), $2.50.

A rental of $1 per year for the first five years and between $1 and the final rental for the next five years is considered equitable. For other dams not classed as power dams in this report the same general basis of rental is considered equitable.

Provision concerning recompense for any increase of power that may be due to any reservoir the United States may build should be included in the contract. This rental will be considered further on under "Etowah storage."

Agreement should be inserted in the contract for Dam No. 13 (1905 No. 18) that the United States may authorize wheels to be installed for extra power when the flow exceeds 12,000 second-feet.

Etowah storage.—It is recommended that the Etowah reservoir be constructed by the General Government, as the benefits to commerce are sufficient to both justify and demand such action. Detailed comparison of these benefits with the improvement of the upper Coosa and the Alabama Rivers by locks and dams is given in the report herewith of Mr. D. M. Andrews, assistant engineer. (Appendix J.)

The increased power due to the Etowah Reservoir is 123,000 10-hour primary horsepower, being (1) 98,000 secondary made into primary power, and (2) 25,000 horsepower additional primary power created, or this 25,000 horsepower may be considered as primary power that was formerly secondary power of lower grade, being available during a shorter period than (1). The difference of value of primary and secondary power is variously stated by various authorities. In this section, where coal is comparatively cheap, this difference is greater than where coal is more costly, and the profitable sale of secondary power will perhaps for a long period be limited to cases where intermittent power can be profitably used or auxiliary steam plants are already installed. The difference in value between this secondary and primary power is estimated to be at least $5 per year per 10-hour horsepower.

It is recommended that each company at a power dam on the lower river be granted the right to utilize the power due to the increased flow created by the reservoir and pay therefor a charge on the basis of $1 per year for the first 5 years, $2 per year for the next 5 years, $3 per year for the following 10 years, on all 10-hour power sold in excess of the amount due to the minimum natural flow of the river, the actual amount of this excess power to be determined by the Secretary of War, and that after 20 years the charge be $3 on all power obtainable.

General.—It is recommended that it be required that the rate of sale to the consumer of all power due in part to Government expenditure for navigation be such as will be equitable to both the power company and the consumer, and that complaints concerning the rate shall be determined by the proper United States courts, to which complaints in all cases the United States shall be a party. As the Etowah Reservoir is in Georgia and the power will be produced in Alabama, United States courts will have jurisdiction. It should be provided that the maintenance and operation of power dams be assumed by the power companies, the variation of the pool level being as directed by the United States within the limits above set forth for obtaining the maximum combined benefits to power and navigation. It should also be provided that power necessary for operation of locks be sold to the United States at an equitable rate.

TALLAPOOSA RIVER RESERVOIRS.

Two reservoir sites have been surveyed on the Tallapoosa River, site No. 1, the lower, being at Cherokee Bluff near Double Bridge Ferry, about 17 miles above Milstead, Ala.; site No. 2, the upper, being just below the mouth of the Little Tallapoosa River.

Site No. 1, Cherokee Bluff.—(*a*) *Available and effective storage.*—Gauge and discharge records of the United States Geological Survey at Sturdevant on this river extend from 1901 to date. The critical dry period in this vicinity was 1903, 1904, and 1905. Drainage area at Sturdevant is 2,334 square miles. The mean annual run-off is 3,744 second-feet. The drainage area at the dam site is 2,848 square miles. The estimated mean annual run-off is 4,200 second-feet, or 132,000,000,000 cubic feet. The loss due to evaporation is figured as above for the Etowah reservoir, being from two to five billion cubic feet for various reservoirs, as seen in Table No. 12 of Appendix I.

The loss due to error of control for navigation is taken as about 5 per cent, the period of prediction being only one day as against a period of two days for the Etowah reservoir. Drawing No. 11 shows the mean monthly run-off at the dam site.

(*b*) *Reservoir capacity and cost.*—The site for a dam at this point is excellent. A dam can be built up to 200 feet high. The estimated cost and capacity with draw-off at 90 feet is as follows:

Height.	Capacity.	Cost.
Feet.	*Billion cubic feet.*	
130	30	$1,850,000
160	69	3,025,000
190	131	4,800,000

Similar data for dam of other heights is given in Table No. 11 and drawing No. 15. So far as known, this reservoir site, considering storage capacity, available flow, reasonable height of dam, and low value of flooded property, is not surpassed.

(*e*) *Effect on navigation and power.*—There are an unlimited number of variations of control for water stored at this site. For any assumed amount of storage different methods of control give different benefits to navigation and to power. Table No. 12 gives the storage capacity required for power alone, or for keeping a specified flow at dam.

Table No. 13 gives storage required for navigation alone, or for keeping a specified minimum flow in the Alabama River at Montgomery with this reservoir alone, or in combination with Etowah Reservoir. Table No. 14 gives various possible combinations in conjunction with Etowah storage. The storage required for any special combination was obtained by adding to the storage necessary for a certain flow at dam, the extra amount required to hold the Montgomery gauge at a certain point after it was held at 6,600 second-feet by Etowah storage. But two combinations or plans will be considered in detail. The benefits to navigation and to power for any other plan can be found in a similar manner. Drawing No. 12 (combined power storage) shows the shortage, or daily flow, at Tallapoosa River site No. 1, to which is added the constant Riverside shortage, which equals 40,000,000,000 cubic feet for 1904. This Riverside constant is the Etowah Reservoir and Coosa local storage (for this purpose assumed to be above Riverside) less losses and draw-off for 1903. This combined power storage curve compared with the Montgomery (or navigation) shortage curve, with any assumed constant flow at dam coinciding with a constant minimum at Montgomery (e. g., dam 2,500 second-feet and Montgomery 8,000 second-feet) gives the total common storage, the extra storage needed for navigation, and the power storage that is of no value to navigation for any combination.

Plan A, 160-foot dam.—A reservoir dam 160 feet high drawn down to 100 feet gives 64,000,000,000 cubic feet of storage. The estimated cost of reservoir dam and flooded lands, with a 25-foot dam in tailrace (which may not be necessary), and equalizing dam in lower river, is $3,025,000. The control proposed is 3,000 second-feet flow at reservoir dam and 9,000 second-feet at Montgomery. As seen from Table No. 14, 60,000,000,000 cubic feet gives this combination. Four billion cubic feet is allowed for loss due to error of control for navigation. Evaporation loss is included in Table No. 14. In extreme emergency, the reservoir can be drawn down to 90 feet.

Benefits to navigation.—Nine thousand second-feet at Montgomery will raise the gauge to +1.95 and with present project regulation (4 feet navigable depth with gauge at zero) will give 6-foot navigation at all times. By further regulation this navigable depth can be increased to meet the increased needs of commerce. Etowah storage will hold the flow at Montgomery at 6,600 second-feet. To raise the flow from 6,600 to 9,000 second-feet, independent of power, will require 29,000,000,000 cubic feet storage capacity on the Tallapoosa River, which demands a dam 120 feet high, the estimated cost of dam and flooded land being $1,480,000, which is the proper limit of navigation expenditure for above results.

Benefits to power.—There are at present two power dams below this proposed reservoir site, their total head being 100 feet. A head of 140 feet can be developed below this reservoir. The low-water flow in 1904 was less than 500 second-feet. It is estimated that with their pondage 800 second-feet minimum flow can be maintained, which will give (in round numbers) a total primary delivered power of 14,000 horsepower (10-hour). A minimum flowage of 3,000 second-feet will give, in round numbers, at the reservoir dam (130 feet power head and 64 per cent efficiency), 68,000 horsepower (10-hour), and at the other dams 52,000 horsepower (10-hour). The total new power is 106,000 horsepower (10-hour). To obtain this power independent of navigation it is estimated that a dam 152 feet high would be required, the cost of dam and flooded lands being $2,540,000, which is the proper limit for power expenditure under this plan.

Plan of cooperation.—It is recommended that the Government expenditure be made $1,480,000, and the power expenditure be made $1,545,000. The saving to the power interests is $995,000, on which they should pay commercial interest in the form of rental on that part of this power created in part by Government expenditure—in this case, 39 per cent of total new power, or 41,000 horsepower (10-hour). Six per cent interest on this saving will more than equal 3 per cent on total Government investment. The following rental is recommended: 50 cents per year for 5 years, and thereafter $1 per year for each 10-hour horsepower on 39 per cent of the total power sold, on which part of the total power provision should be made for equitable sale and proper time limit of lease.

Plan B, 131-foot dam.—Reservoir dam 131 feet high, drawn down to 90 feet, gives 30,000,000,000 cubic feet storage capacity. The estimated cost, including equalizing dam, is $1,850,000. The control proposed is 2,500 second-feet at dam and 8,000 second-feet at Montgomery, including Etowah storage.

Benefits to navigation.—Eight thousand second-feet at Montgomery will raise the gauge to +1.5 feet and with regulation exceeding present project (4 feet at zero) will give 6-foot navigation. To obtain this benefit independent of power would require a dam 100 feet high, which would cost $1,086,000, which is the limit of proper navigation expenditure under this plan.

Benefits to power.—This plan gives total power, in round numbers, on above-named basis of 50,000 horsepower (10-hour) at reservoir dam and 110,000 horsepower (10-hour) at reservoir and other dams, or 96,000 horsepower (10-hour) new power. To obtain this power independent of navigation would require a dam 128 feet high, estimated to cost $1,675,000, which is the proper limit of power expenditure on dam and flooded land under this plan. Under this plan, the Government expenditure of $1,086,000 and rental of $1 per year for five years, thereafter $1.50 per year per 10-hour horsepower on 65 per cent of total power sold, is recommended. The Government expenditure on dam helps create 65 per cent total new power.

Plan recommended.—It is understood that the present plan of the power interests owning this site is to build a dam 130 feet high. The 130-foot dam is proportionally more economical than a higher structure, as up to a flow of 2,500 seond-feet at the dam the surplus of a year such as 1905 is sufficient for the shortage (navigation and power) of that year. This 130-foot development is required to provide for but a one-year storage. A greater storage than given by a 130-foot dam drawn down to 90 feet must provide for shortage through a period of three years. A 190-foot dam drawn down to 90 feet will practically equalize the flow of the river. Such a dam would be nearly full only a small portion of the time, with a resulting loss of power head. It may perhaps eventually be proper to build the 200-foot dam for the increased power head, the draw-off being limited as may be most beneficial, reservoir No. 2 at Blakes Ferry being built for extra storage. Ten thousand second-feet is considered a proper limit for navigation, as it will give 6-foot navigation with moderate regulation, and with that flow 9-foot navigation can, it is believed, eventually be obtained by regulation. This flow could be obtained at an estimated cost of $2,350,000 by a dam 149 feet high if controlled for navigation only. Any plan for a higher dam depends on the power interests. No recommendation for storage for navigation alone is made at this time. It is believed that now, as the possibilities are known, some agreement can be reached. Any plan up to a 200-foot dam is recommended for approval, the method of control and relative share of costs and benefits to be based on above data. A clear-cut and satisfactory method of procedure would be to let the contract to the power interests for building the dam for the amount of proper navigation expenditure and in this contract incorporate any desirable agreement as to rental and also equitable sale of power due to Government expenditure. The maintenance and operation of this reservoir under the plan agreed upon should be borne by the power company.

Equalizing dam.—In order that this power may be used as 10-hour power and navigation may also receive the full benefit of storage, it will be necessary to construct an equalizing dam lower down on this river. The estimated cost of this dam is $100,000, which is included in totals for above plans A and B. In case the water-power interests construct the storage dam independently of the Government, the Government can, by building this equalizing dam, obtain decided benefits from this storage. The estimated cost of maintenance and operation of this dam is $5,000 per year.

Site No. 2, or Blakes Ferry.—The drainage area at this dam site is practically one-half the drainage area at site No. 1; the run-off, therefore, will be slightly greater than one-half of the run-off at that site, which will be amply sufficient to fill any reservoir that can be built at this site.

With a dam 130 feet high, the estimated capacity is 11,000,000,000 cubic feet, the estimated cost of this dam and the flooded lands being $1,340,000, or $122 per million cubic feet of storage.

The effective storage is estimated as 9,000,000,000 cubic feet, if the stored water is used during the same year in which it is caught. If it is used in conjunction with other reservoirs, where the storage must be held for a longer period, the loss due to evaporation will correspondingly increase.

It is recommended that this reservoir be not further considered, as all the available storage of this stream can be caught in reservoir No. 1.

FLOOD CONTROL.

The Etowah Reservoir will reduce the floods at Rome, Ga., ordinarily by perhaps 50 per cent. The Tallapoosa Reservoir will reduce the floods at Montgomery by perhaps 12 per cent. Full discussions of these effects are given in report of Mr. D. M. Andrews, assistant engineer, Appendix J.

GENERAL SUMMARY.

The engineering constructions proposed present no uncertain feature or especial difficulties. Foundations and abutments for all high dams, both reservoir and power, are good, being granite and gneiss. The heights of dams and lifts of locks are within the limits of existing structures. For safety, canals are provided around high dams. There is no ice to contend with. Construction materials, stone, sand, iron, cement, and lumber are conveniently near. Labor in this section is of good quality. The estimates of cost have been made reasonably liberal, and it is believed the work can be completed within the amounts named. The estimates for power equipment to be installed are based on correspondence with makers of hydraulic and electric equipment. These estimates are sufficiently close to show that, if necessary, the Government can profitably make complete installation at any site.

The reservoirs are ordinarily controlled for certain flow at power dams, and during periods of extreme low water an extra flow is allowed at the Tallapoosa Reservoir. The pondage at Coosa power dams and equalizing dam prevent great loss (estimated at 10 per cent); the Tallapoosa Reservoir is about one day above Montgomery (5 per cent loss is allowed). Though the method of control will be beneficially changed with experience, the method proposed would, during the last 20 years, have given the results stated. It is thought to be very probable that, after all the power developed under the plan proposed has been sold, instead of basing the control on the extreme low-water year, it will be found profitable to base control on an ordinary low-water year, and bear the risk of slight diminution in extreme years to gain the increased power and navigation benefits during all ordinary years.

The division of cost and the "compensation to the Government for expenditures for navigation," as above recommended, are believed to be free from any conflict with existing laws, principles, or vested rights and to be just and equitable to all parties concerned. The Government has not been presumed to be a commercial institution. It is provided that any earnings above those used on this river system be given to this section by providing for equitable sale of power due to Government investment for navigation. The natural water-power rights are taken to belong to the State, or to whomsoever the State has granted them. The Government expenditure is limited by the benefits received for navigation. The rental is based on value received.

Provision for reservoirs insures all-year navigation on the lower river and makes the entire project feasible beyond question. The rental received will cover maintenance, operation, and betterments for the river system. These receipts could be made to support, and within a reasonable time retire, bonds for a large portion of the Government expenditure should such method be desired.

On the other side, the benefits to the power interests, as heretofore set forth, are very great; their initial expenditures are reduced to amounts justified by the power that can be readily sold, and they will eventually receive the benefits of the total development which would have cost them vastly greater sums. The physical coordination necessary for the proper development is secured by Government cooperation and the control for maximum benefits to navigation and power. It is thought that the provisions as to rental and equitable sale of power due in part to Government expenditure should be acceptable to all parties concerned. Provision for the completion of the navigation works by the time the power is developed will allow economic location of power-using plants near the river where low rates are assured on raw material and finished products. This coordinate development will provide for the most economical utilization of many of the abundant natural resources of this section.

All the foregoing overlapping benefits to navigation and power are the savings due to coordination or the carrying on of both developments at the same time under the plan for expenditure proposed. Either interest proceeding alone means the failure to realize the benefits secured by the combined project, and any division of the initial expenditure whereby the Government expenditure is not the total navigation share will mean an initial loss to the power interests and an eventual loss to the United States.

COMMERCE.

In addition to the data submitted with the preliminary report there are submitted herewith certain pledges as to wharves, etc., and some data concerning the making of atmospheric nitrogen and pig iron and steel with electric furnaces. Since the preliminary report was submitted a steel plant has been constructed at Gadsden, Ala., whose output, it is stated, will be about 500 tons per day. Motors aggregating about 12,000 horsepower are installed in this plant. Reference is made to letter of the manager of this company in Appendix K herewith.

Pledges.—Table F gives the various wharves, railway connections therewith, boats, and barges pledged by various localities and persons, and also estimates as to freight. The various pledges are herewith as Appendix K, except in the case of Montgomery, where the wharf is completed according to the plans in the regular files of the War Department. It is believed that the estimates of this table are conservative, and with the opening of navigation will be found to be rather under than above the actual commerce of the river. The fulfillment of these pledges, so far as they relate to cities or towns, together with requirements for other towns, is recommended as conditions governing the availability of the expenditures from any appropriation which may be made.

TABLE F.

	Modern wharves.	Steam or electric connections.	Boats.	Barges.	Freight per year (308 days).				
					Amount.	Rate per ton.		Difference.	Total saving.[1]
						Rail.	River		
Pledged by—					*Tons.*				
Rome, Ga.	1	1	2	5					
Gadsden, Ala.	1	1							
Montgomery, Ala.	[2] 1	1	(3)	(3)					
Brick Co., Ragland, Ala.	1	1	1	[4] 4	46,200	$2.00	$1.00	$1.00	$46,200
Coal Co., Ragland, Ala.	1	1	1	[4] 10	616,000	1.80	1.00	.80	492,800
Cement Co., Ragland, Ala.	1	1	(5)	(5)	200,000	2.00	1.00	1.00	200,000
Total					862,200				739,000
Definite estimates by—									
Steel Co., Gadsden, Ala.					77,000	2.50	1.00	1.50	115,500
Marble Co., Talladega County, Ala.				[5] [6] 5	60,000	2.60	1.00	1.60	96,000
Cotton Mill, Lindale, Ga.[7]					7,800	8.00	2.00	6.00	46,800
Total tonnage and saving in freight per year.					1,007,000				997,300

[1] Based on Appendix H of preliminary examination report and estimated water rates.
[2] Plans for wharf approved by Secretary of War; wharf completed.
[3] Citizens' boat and barge line organized at Montgomery; part of capital subscribed; one boat has been purchased.
[4] Each 200 tons.
[5] If not operated by common carriers, to be operated by cement and marble companies, as per their letters.
[6] Each 500 tons.
[7] The number of cotton mills in this section is given in the preliminary report.

Atmospheric nitrogen.—The production of nitrogen from the atmosphere has passed from the experimental to the commercial basis. There is attached hereto, in Appendix K, a list of cyanamid plants as published by the Niagara Falls Co. These plants are in Germany, Norway, Italy, Switzerland, France, and Japan. It is reported in the technical press that recently one 250,000-horsepower plant using another method has been built in Norway. Some references from Daily Consular and Trade Reports concerning this item are also included in this appendix. The importance of these perfected processes can scarcely be estimated. Their bearing on this particular project is that they offer a great field for some of the power developed and will increase the commerce on the river.

There is also herewith, in Appendix K, a list of estimated consumption of fertilizers in some of the Southern States. The amount of fertilizer used in Georgia, Alabama, Mississippi, and Louisiana is estimated at 1,279,093.85 tons per year. This consumption will necessarily increase. It is noted that the demand for raw cotton from the South in 20 years from now is estimated at 26,000,000 bales, twice the present crop; the present normal increase will give but 17,000,000 bales in 20 years. Of all the Appalachian water powers the Coosa-Tallapoosa system is farthest to the Southwest.

Electric steel.—Electric furnaces have been constructed for the reduction of iron ore into pig iron. Electric furnaces have also been constructed for the making of steel from pig iron. There are electric steel plants in Europe and in the United States. In the discussion of some of these plants it is noted that the cost of production bids fair to make this method a competitor against cheap coal. Certain superior qualities are also claimed for the finished product. The tempering of steel by use of the electric bath is now also accomplished.

The above developments are mentioned because they, in common with steel plants, cotton mills, and atmospheric nitrogen plants, will utilize water power and add to the commerce of the river.

Government-aided railroads.—As bearing on the fact that the general direction of this river system is a logical direction for transportation lines, and that this fact has long been financially recognized by the General Government, there is attached hereto map No. 14, showing Government-aided railroads in the vicinity of this river system.

CONCLUSIONS AND RECOMMENDATIONS.

It is, in my opinion, practicable to construct reservoirs at the headwaters as above stated and estimated, and thus make possible, with very reasonable regulation, 6-foot navigation on the Alabama River. Nine-foot navigation can eventually be obtained by the necessary regulation when required. The power will be increased as above set forth. It is possible to coordinate the interests of navigation and water power development and the saving thereby will be over eight millions of dollars.

It is recommended that the plan adopted be the one set forth in Table E. This plan provides for 14 dams on the Coosa River between Gadsden and Wetumpka, and for the Etowah Reservoir. The amount of the Government expenditure recommended at each site is shown separately for the locks and dams in Table E. The totals are as follows:

For 8 low dams and all locks on Coosa River, 10 single locks, and 4 flights of 2 locks	$6, 990, 000
For navigation share of 6 high dams on Coosa River	4, 013, 000
For Etowah Reservoir	4, 000, 000
Total	15, 003, 000

The terms on which the power interests can carry on their share of the construction should be definitely specified. Terms that are considered equitable as to rental and as to sale of power have been stated on pages 50–52 of this report.

As to the Tallapoosa Reservoir No. 1, while no recommendation of specific amount is made pending some definite agreement with the power interests, it is recommended that when such agreement is concluded the expenditure, method of control, and rental be according to data above given.

In order that the Coosa-Alabama River system may be utilized to its full value as a factor in the development of this section, and in order that the factories which will use electric power receive the greatest commercial advantages due to cheap transportation, it is, in my opinion, essential that all works necessary for opening the river for navigation shall be completed as early as the power installations at the high dams.

The estimate for the Etowah Reservoir is based on present value of flooded land. This proposed flooded area will be encroached on by towns and commercial plants which, for all economic reasons, might just as well be located beyond the flood limit. Reservoir sites of this type are rare. The construction of this reservoir is part of the most advantageous plan for the development of this river system, and it is recommended that in the interests of economy without reference to the time of construction provision be made for the acquisition of this site, at least in the vicinity of Acworth and Canton, Ga., as soon as possible.

This locality is, in my opinion, worthy of improvement to the extent above recommended, and it is further recommended that the money appropriated be made available only when public wharves, warehouses, and freight-handling facilities and steam or electric railway connections therewith, as may be approved by the Secretary of War, shall have been constructed, or bond equal to their estimated cost shall have been made for such construction at Selma, Wetumpka, Riverside, Ragland, Gadsden, Ala., and Rome, Ga.

Very respectfully,

H. B. Ferguson,
Captain, Corps of Engineers.

The Chief of Engineers, United States Army
(Through the Division Engineer).

[Third indorsement.]

OFFICE DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., December 29, 1910.

1. Respectfully forwarded to the Chief of Engineers, United States Army.

2. The report of the district officer shows a thorough and careful study of the question and presents the various aspects of the case quite fully. The conclusions with regard to storage discharge and the effect upon the lower reaches of the river are probably as accurate as can be made in advance, but natural streams are quite different from artificial channels and each forms to a certain extent a rule to itself on account of the manner in which the waterway widens and the spacing and character of effluent streams. The amount of discharge necessary to produce a given effect upon the lower river will have, therefore, to be a matter of experience and can probably not be determined definitely in advance. The difference between theory and practice will, however, not be sufficient to materially affect the conclusions drawn.

3. The rates of rental for water power have been carefully considered and are regarded as being as equitable as any which can be laid down at this time. Economic conditions and also conditions of operation upon the rivers are likely to change or vary somewhat with the progress of the work and the commercial development of the region. On this account it is not believed advisable to attempt to fix the rates too far in advance. Probably 10-year intervals would be sufficient. As, however, parties using water power must have comparatively definite data in order to enable them to intelligently invest their capital, the rates could be made definitely for a fixed amount for a 10-year period with statement that it would not vary more than a certain per cent, or beyond certain limits, during a further period that might be determined. As the Engineer officer in charge of the district is changed from time to time and as individual officers would probably hold different ideas upon the subject, and as it is desirable to avoid changes in rates due to individual opinions, it might perhaps be advisable to assign the matter of regulation of rates to a board of three officers most conversant with the improvement and local conditions.

4. The engineering features of the project have been carefully worked out and the conclusions appear to be sound and, subject to the slight modification as to determination of rental values above indicated, the report is concurred in.

LANSING H. BEACH,
Lieut. Col., Corps of Engineers,
Division Engineer.

[For Report of the Board of Engineers for Rivers and Harbors on survey, see pages 3–7.]

Appendix I.

Table No. 4.—*Etowah Reservoir—Available storage—Annual run-off at gauge stations above Riverside, Ala.*

[In second-feet, totals, and per square mile. From U. S. Geological Survey records. Computed figures are in parenthesis.]

	Coosa River.		Oostanaula-Coosawattee Rivers.		Etowah River.			
	River-side.	Rome.	Resaca.	Carters.	Rome.	Canton.	Ball Ground.	Proposed reservoir dam.
Drainage area (square miles)	7,065	4,006	1,614	531	1,800	604	396	1,023
1897	9,282	6,070	2,844	891		1,134		
	1.31	1.52	1.76	1.67		1.87		
1898	9,329	6,111	2,838	938		1,337		
	1.32	1.52	1.76	1.76		2.21		
1899	12,189	7,906		1,185		1,721		
	1.73	1.97		2.23		2.85		
1900	14,623	8,218				1,700		
	2.07	2.05				2.81		
1901	16,092	10,103		1,777		1,938		
	2.28	2.52		3.35		3.21		
1902	12,285	6,920		1,111		1,454		
	1.74	1.73		2.09		2.41		
1903	14,849	8,932		1,337		1,782		
	2.10	2.23		2.52		2.96		
1904	4,945			539		605		
	0.70			1.01		1.00		
1905	10,900		2,645	1,043	2,670			
	1.54		1.64	1.97	1.48			
1906	15,600		4,600	1,650	4,560			
	2.21		2.86	3.12	2.53			
1907	11,200		2,940	1,170	2,820			
	1.59		1.82	2.21	1.56			
1908	11,300		2,810	1,090	2,850		1,091	
	1.60		1.74	2.06	1.58		2.76	
Mean	(1.68)	(1.82)	(1.82)		(1.82)	(2.52)		(2.23)

Mean annual run-off at dam site, 2,280 second-feet, equals 69,000,000,000 cubic feet.
Run-off, 1903, 2,563 second-feet, equals 77,000,000,000 cubic feet.

Table No. 5.—*Etowah reservoir—Available storage—Annual rainfall, run-off, and losses, Alabama River Basin and adjacent.*

[Compiled and computed from reports of U. S. Geological Survey and Weather Bureau.]

COOSAWATTEE RIVER ABOVE CARTERS, GA.

[Drainage area, 531 square miles.]

Year.	Rainfall.	Run-off.	Loss.	Percentage loss.
	Inches.	*Inches.*	*Inches.*	
1897	55.40	28.44	26.96	0.49
1898	59.97	28.80	31.17	.52
1899	54.73	32.88	21.85	.40
1900	65.03	33.36	31.67	.49
1901	71.52	54.48	17.04	.24
1902	47.24	34.20	13.04	.29
1903	56.29	40.80	15.49	.26
1904	43.66	17.40	26.26	.60
1905	64.13	26.76	37.37	.58
1906	67.85	51.12	16.73	.24
1907	54.08	37.68	16.40	.30
Average	58.17	35.08		
Per cent		60.31		
1897–1902			141.73	.45
1898–1903			130.26	.37
1899–1904			125.35	.38
1900–1905			140.87	.41
1901–1906			125.93	.38
1902–1907			125.29	.37

TABLE No. 5.—*Etowah reservoir—Available storage—Annual rainfall, run-off, and losses, Alabama River Basin and adjacent*—Continued.

COOSA RIVER ABOVE ROME, GA.

[Drainage area, 4,006 square miles.]

Year.	Rainfall.	Run-off.	Loss.	Percentage loss.
	Inches.	*Inches.*	*Inches.*	
1897	49.47	21.24	28.23	0.57
1898	55.50	21.60	33.90	.61
1899	50.59	26.28	24.31	.48
1900	59.75	25.92	33.83	.56
1901	64.80	34.08	30.72	.47
1902	45.90	22.80	23.10	.50
1903	52.63	29.40	23.23	.44
1904	41.01			
1905	56.23			
1906	61.09			
1907	49.32			
1897–1902			174.09	.53
1898–1903			169.09	.51

COOSA RIVER AT RIVERSIDE, ALA.

[Drainage area, 7,065 square miles.]

Year.	Rainfall.	Run-off.	Loss.	Percentage loss.
1897	40.32	17.52	22.80	0.56
1898	53.87	17.04	36.83	.68
1899	51.50	21.96	29.54	.57
1900	61.89	26.40	35.49	.57
1901	63.22	28.92	34.30	.54
1902	46.88	22.32	24.56	.53
1903	51.52	24.00	27.52	.53
1904	39.31	8.16	31.15	.79
1905	54.64	19.80	34.84	.64
1906	61.32	27.72	33.60	.55
1907	50.43	20.28	30.15	.60
1897–1902			183.52	.57
1898–1903			188.24	.57
1899–1904			182.56	.59
1900–1905			187.86	.60
1901–1906			185.97	.60
1902–1907			181.82	.61

TALLAPOOSA RIVER ABOVE MILSTEAD.

[Drainage area, 3,620 square miles.]

Year.	Rainfall.	Run-off.	Loss.	Percentage loss.
1898	51.27	14.40	36.87	0.72
1899	48.22	19.44	28.78	.60
1900	64.85	23.04	41.81	.65
1901	59.17	24.48	34.69	.59
1902	55.69	19.68	36.01	.65
1903	50.83	24.96	25.87	.51
1904	41.54	9.60	31.94	.77
1905	50.30	13.92	36.38	.72
1906	56.36	23.04	33.32	.59
1907	51.23	21.12	30.11	.59
1898–1903			204.03	.62
1899–1904			199.10	.63
1900–1905			206.70	.65
1901–1906			198.21	.64
1902–1907			193.63	.64

TALLAPOOSA RIVER ABOVE STURDEVANT.

[Drainage area, 2,334 square miles.]

Year.	Rainfall.	Run-off.	Loss.	Percentage loss.
1901	56.78	27.00	29.78	0.52
1902	51.15	22.80	28.35	.55
1903	50.58	28.20	22.38	.44
1904	36.50	10.92	25.58	.70
1905	50.00	17.64	32.36	.65
1906	56.38	31.44	24.84	.44

TABLE No. 5.—*Etowah reservoir—Available storage—Annual rainfall, run-off, and losses, Alabama River Basin and adjacent-* Continued.

ALABAMA AND COOSA RIVERS AT SELMA, ALA.

[Drainage area, 15,400 square miles.]

Year.	Rainfall.	Run-off.	Loss.	Percentage loss.
	Inches.	*Inches.*	*Inches.*	
1897	44.79	17.04	27.75	0.62
1898	50.07	15.24	34.83	.69
1899	48.80	22.32	26.48	.54
1900	64.08	27.00	37.08	.58
1901	59.70	29.64	30.06	.54
1902	49.49	24.96	24.53	.50
1903	51.81	25.32	26.49	.51
1904	38.99	9.96	29.03	.75
1905	53.09	18.48	34.51	.65
1906	59.74	27.48	32.26	.54
1907	52.44	22.32	30.12	.58
1897-1902			180.73	.58
1898-1903			179.47	.56
1899-1904			173.67	.57
1900-1905			181.70	.59
1901-1906			176.88	.58
1902-1907			176.94	.59

FLINT RIVER ABOVE ALBANY, GA.

[Drainage area, 5,000 square miles.]

1897	45.33	20.52	24.81	0.55
1898	57.18	17.04	40.14	.70
1899	42.81	18.12	24.69	.58
1900	55.74	20.64	35.10	.63
1901	58.53	26.64	31.89	.55
1902	50.47	20.28	30.19	.60
1903	56.77	24.60	32.17	.57
1904	37.19	14.04	23.15	.62
1905	50.47	16.08	34.39	.68
1906	50.26	20.40	29.86	.59
1907	52.75	20.40	32.35	.61
1897-1902			186.82	.60
1898-1903			194.18	.60
1899-1904			177.19	.59
1900-1905			186.89	.61
1901-1906			181.65	.60
1902-1907			182.11	.61

CHATTAHOOCHEE RIVER ABOVE WEST POINT, GA.

[Drainage area, 3,300 square miles.]

1897	47.11	18.60	28.51	0.61
1898	57.15	19.68	37.47	.65
1899	46.68	21.84	24.84	.53
1900	63.04	29.88	33.16	.53
1901	65.65	31.32	34.33	.51
1902	49.44	24.96	24.48	.50
1903	53.60	28.32	25.28	.47
1904	31.90	11.76	20.14	.66
1905	50.19	16.20	33.99	.68
1906	59.16	28.80	30.36	.51
1907	46.73	19.92	26.81	.58
1897-1902			182.79	.55
1898-1903			179.56	.53
1899-1904			162.23	.53
1900-1905			171.38	.56
1901-1906			168.58	.55
1902-1907			161.06	.57

TABLE No. 5a.—*Annual rainfall, Alabama River Basin and adjacent, 1856–1904.*

Year.	Inches.	Year.	Inches.
1856	49.88 46.49 50.63 54.11	1881	55.71 53 91 48.29 52.40
1860	46.34 45.61 37.81 55.79 48.27	1885	55.74 55.98 47.94 56.30 44.26
1865	50.09 51.72 39.95 53.16	1890	45.35 52.06 58.45 48.41 44.16
1870	45.58 56.98 52.44 48.87 55.93	1895	48.43 39.44 44.42 47.43 46.38
1875	55.04 46.25 53.04 45.18 49.87	1900	63.81 55.85 49.24 50.67 36.62
1880	59.20		

The above table is condensed from compilation made by Mr. Henry C. Jones, of Montgomery, Ala. Mr. Jones kindly loaned this office the original compilation which gives the rainfall by months.

The method of arriving at total annual rainfall is by taking the average for all stations where records were obtained. In Table No. 5 and in Table No. 1 of the preliminary reports the total annual rainfall was obtained by allowing a certain weight for record at each station, depending on area of watershed that was considered affected.

TABLE No. 6.—*Etowah Reservoir—Effective storage.*

EVAPORATION ON RESERVOIR.

	Inches.	Billion cubic feet.
1903.		
Rainfall, August–December	10.0	....
Less 50 per cent run-off already counted	5.0	....
Evaporation on reservoir (Augusta, Ga., records)	18.0	....
Net evaporation	13.0	....
40 square miles, at 13 inches	....	1.2
1904.		
Rainfall, June–December	22.0	....
Less 50 per cent	11.0	....
Evaporation on reservoir (Augusta, Ga., records)	30.4	....
Net evaporation	19.4	....
30 square miles, at 20 inches	....	1.4

TABLE No. 6.—*Etowah Reservoir—Effective storage*—Continued.

STORAGE ACCOUNT THROUGH CRITICAL PERIOD, 1903-4-5.

[Reservoir capacity, 40,000,000,000 cubic feet.]

	Billion cubic feet.		
	Minus.	Plus.	In reservoir.
1903.			
Full, July			42.0
Draw-off, August-December	10.0		32.0
Evaporation loss on reservoir, August-December	1.2		30.8
Loss in control, about 10 per cent	0.9		29.9
1904.			
Caught, January, February, March, April		9.1	39.0
Draw-off, effective, 1904	30.0		9.0
Caught in August and December		4.4	13.4
Evaporation loss on reservoir, June-December	1.4		12.0
Increased evaporation on river, 15 square miles, at 20 inches	0.7		11.3
Error in control, about 10 per cent	3.6		7.7
Difference of phase of shortage at Riverside and at Montgomery	7.7		0.0
1905.			
Caught during year		42.0	42.0

Total effective storage for 1904 is 37.7 billion cubic feet if regulated for navigation alone, or 30,000,000,000 cubic feet if regulated for navigation and power. Effect of this storage is seen on curve for 1904 on drawings Nos. 6 and 7.

TABLE No. 7.—*Estimated monthly discharge of Coosa River at Riverside, Ala.*

[Drainage area, 7,065 square miles.]

[From Water-Supply and Irrigation Papers of the United States Geological Survey.]

Month.	Discharge in second-feet.			Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.
1897.				1899.			
January	21,707	2,420	8,434	January	17,330	6,390	10,865
February	27,086	4,520	18,658	February	48,410	17,330	30,974
March	47,624	10,460	32,481	March	60,880	14,740	38,094
April	37,355	5,100	17,698	April	41,010	11,410	24,915
May	10,786	4,270	7,040	May	14,000	4,900	7,742
June	4,950	3,070	3,915	June	7,700	3,500	4,771
July	23,826	3,070	7,142	July	14,740	2,760	5,318
August	6,300	2,850	3,870	August	10,125	2,600	3,806
September	3,540	1,440	1,976	September	6,530	2,330	3,555
October	3,660	1,350	1,819	October	3,100	2,330	2,510
November	2,525	1,570	1,786	November	7,100	2,395	3,086
December	13,883	1,820	6,566	December	26,025	2,920	10,631
The year.	47,624	1,350	9,282	The year.	60,880	2,330	12,189
1898.				1900.			
January	35,084	3,550	11,572	January	33,100	4,280	13,344
February	16,760	3,655	5,763	February	54,300	5,700	23,487
March	15,045	3,550	5,852	March	44,500	13,450	26,822
April	36,160	8,260	18,133	April	65,500	11,350	29,813
May	9,560	3,028	4,684	May	14,850	5,970	8,198
June	5,540	2,320	3,281	June	51,500	5,970	22,216
July	9,900	2,140	4,289	July	39,500	5,565	13,610
August	19,161	3,970	8,758	August	12,750	4,050	5,147
September	41,920	3,865	13,927	September	23,100	2,760	6,483
October	72,160	3,760	19,936	October	23,100	3,100	6,910
November	20,190	5,300	8,375	November	29,900	3,720	7,673
December	9,900	5,070	7,376	December	22,300	5,835	11,773
The year.	72,160	2,140	9,329	The year.	65,500	2,760	14,623

TABLE NO. 7.—*Estimated monthly discharge of Coosa River at Riverside, Ala.*—Continued.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1901.			
January	55,900	8,970	26,089
February	41,100	8,970	21,784
March	56,700	7,400	20,613
April	51,100	14,500	30,616
May	40,700	6,670	16,195
June	26,100	6,810	12,335
July	10,300	4,900	6,535
August	44,700	4,400	20,370
September	23,100	5,700	9,977
October	10,300	4,280	5,694
November	4,650	3,830	4,016
December	57,100	4,050	18,885
The year.	57,100	3,830	16,092
1902.			
January	55,900	6,670	23,804
February	51,500	12,050	24,839
March	62,300	14,850	34,762
April	55,100	8,330	20,872
May	8,330	4,900	6,375
June	4,900	3,830	4,247
July	6,670	3,015	3,718
August	5,430	2,760	3,577
September	10,300	2,610	3,938
October	10,300	2,760	4,576
November	9,950	2,685	3,994
December	24,300	5,430	12,719
The year.	62,300	2,610	12,285
1903.			
January	21,710	6,610	12,066
February	67,500	10,680	43,155
March	58,470	17,930	40,682
April	52,450	12,370	28,983
May	30,740	6,460	11,294
June	36,540	6,460	15,654
July	21,710	5,010	7,994
August	14,890	3,180	5,910
September	4,880	2,800	3,211
October	3,590	2,620	2,922
November	4,510	2,800	3,334
December	3,380	2,710	2,983
The year.	67,500	2,620	14,849
1904.			
January	14,440	2,620	5,228
February	17,940	4,130	8,391
March	20,900	5,560	11,370
April	14,800	4,765	7,462
May	5,970	2,527	3,676
June	7,135	2,255	3,598
July	5,970	2,435	3,314
August	18,680	2,527	6,118
September	2,620	1,528	1,987
October	1,605	1,225	1,351
November	1,920	1,225	1,713
December	14,800	1,760	5,127
The year.	20,900	1,225	4,945

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1905.			
January	43,650	5,028	14,500
February	50,310	6,250	30,340
March	20,340	7,440	11,710
April	9,080	5,970	7,266
May	34,400	6,110	14,650
June	10,130	4,380	6,259
July	18,860	3,655	7,990
August	14,800	3,112	6,813
September	5,028	2,255	3,203
October	7,440	2,255	3,921
November	3,215	2,528	2,838
December	35,880	3,215	21,330
The year.	50,310	2,255	10,900
1906.			
January	42,200	11,700	22,600
February	16,000	5,700	8,530
March	75,800	6,540	34,400
April	37,500	7,140	14,800
May	11,000	4,640	6,850
June	31,900	4,380	10,100
July	46,400	5,030	17,600
August	17,500	7,440	11,200
September	15,300	5,560	10,500
October	44,700	6,980	20,400
November	46,400	5,160	17,700
December	31,900	7,290	12,300
The year.	75,800	4,380	15,600
1907.			
January	45,100	7,750	15,700
February	40,400	8,700	19,600
March	51,100	7,440	19,700
April	18,300	7,440	10,600
May	38,300	9,660	15,900
June	29,000	5,290	10,800
July	9,020	4,130	5,980
August	7,140	3,320	5,300
September	21,800	2,620	6,400
October	10,300	2,810	4,090
November	31,100	3,010	9,420
December	27,300	5,420	11,500
The year.	51,100	2,620	11,200
1908.			
January	35,800	8,220	18,000
February	53,700	15,300	30,300
March	47,700	9,980	20,300
April	26,900	8,380	15,900
May	14,500	6,690	10,300
June	9,340	4,130	5,960
July	11,700	3,110	4,930
August	9,340	2,910	4,920
September	10,600	2,260	3,650
October	6,980	2,080	2,800
November	3,660	2,340	2,750
December	41,700	2,720	15,500
The year.	53,700	2,080	11,300

TABLE NO. 8.—*Etowah Reservoir.*

[Reservoir capacity and cost.]

Height of dam (spillway height, in feet).	Flooded land (square miles).	Storage capacity (million cubic feet).	Total cost.	Cost per million cubic feet.
40	0.43	(1)	....	....
64	1.04	0.434	....	....
84	2.44	1.318	....	....
104	6.38	3.607	....	....
124	12.55	8.793	....	....
144	20.27	17.743	....	....
164	31.76	31.920	$3,260,000	$102.13
174	41.07	42.020	4,000,000	95.20

[1] Limit of draw-off.

TABLE No. 9.—*Estimated monthly discharge of Tallapoosa River at Sturdevant.*

[Drainage area, 2,334 square miles.]

[From Water-Supply and Irrigation Papers of the U. S. Geological Survey.]

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1901.			
January	20,345	4,690	7,035
February	18,485	4,535	6,468
March	12,285	3,450	5,315
April	12,440	4,535	6,772
May	10,270	3,140	4,885
June	7,170	2,365	4,452
July	5,155	1,640	2,795
August	16,625	1,640	4,793
September	9,340	1,640	2,852
October	7,790	1,220	1,946
November	2,055	1,220	1,502
December	24,150	1,310	4,670
The year.	24,150	1,220	4,457
1902.			
January	15,695	2,520	4,550
February	23,245	3,760	6,288
March	23,245	5,310	9,708
April	10,890	3,914	5,677
May	5,000	1,910	3,240
June	4,070	840	1,544
July	2,830	660	1,004
August	7,790	470	1,298
September	4,845	510	1,255
October	2,985	715	1,180
November	6,550	660	2,011
December	10,890	1,640	4,412
The year.	23,245	470	3,514
1903.			
January	4,120	2,320	3,128
February	27,370	2,470	9,841
March	15,070	5,320	8,035
April	14,470	4,420	6,988
May	19,120	3,370	5,688
June	10,720	2,770	4,845
July	7,270	1,500	3,204
August	6,970	1,110	2,771
September	3,370	765	1,271
October	2,620	765	939
November	1,750	912	1,285
December	2,920	1,036	1,410
The year.	27,370	765	4,117
1904.			
January	7,760	1,264	2,500
February	8,860	2,230	4,089
March	6,490	1,757	2,749
April	3,410	1,352	1,757
May	2,495	558	991
June	5,330	377	1,084
July	2,780	418	1,086
August	34,200	1,105	5,855
September	2,230	509	850
October	509	250	314
November	1,545	275	722
December	6,250	717	1,562
The year.	34,200	250	1,966
1905.			
January	40,510	1,100	4,977
February	20,350	1,850	6,897
March	10,560	2,440	3,647
April	4,250	2,040	2,694
May	4,450	1,460	2,744
June	2,730	885	1,459
July	4,660	710	1,540
August	13,950	554	2,754
September	1,790	296	677
October	1,910	416	929
November	1,460	656	889
December	22,910	950	7,411
The year.	40,510	296	3,052
1906.			
January	29,600	2,730	6,770
February	4,060	2,370	3,020
March	59,100	2,440	12,700
April	7,800	2,660	4,010
May	11,400	1,910	3,160
June	16,500	1,460	3,230
July	17,200	1,460	6,140
August	20,000	2,440	5,310
September	19,100	2,300	5,540
October	20,000	2,300	6,140
November	20,700	2,170	4,000
December	21,000	2,440	4,660
The year.	59,100	1,460	5,390
1907.			
January	22,000	3,040	4,940
February	27,100	3,430	8,030
March	24,500	3,040	6,280
April	12,700	2,600	5,600
May	21,000	3,600	6,810
June	5,550	1,960	3,110
July	4,320	1,270	2,300
August	4,130	915	1,660
September	4,420	635	1,270
October	2,020	690	912
November	15,600	750	3,140
December	14,000	1,720	4,840
The year.	27,100	635	4,070
1908.			
January	11,700	2,600	4,510
February	33,200	4,130	9,900
March	20,700	3,040	5,340
April	16,200	2,740	5,310
May	7,020	2,600	3,990
June	3,950	1,270	2,220
July	3,770	1,100	1,790
August	4,710	750	1,800
September	5,120	530	1,080
October	1,510	505	715
November	6,010	880	1,370
December	12,000	985	2,690
The year.	33,200	505	3,390

TABLE No. 10.—*Tallapoosa Reservoir No. 1, Cherokee Bluff—Storage account.*

[Discharge is from United States Geological Survey records at Sturdevant multiplied by 1⅛; Sturdevant drainage area is 2,334 square miles; reservoir dam drainage area is 2,848 square miles.]

Month.	Second-feet.						
	Discharge.	Surplus above 3,000.	Shortage below 3,000.	Amount required in reservoir.	Surplus above 2,500.	Shortage below 2,500.	Amount required in reservoir.
1903.							
January	3,519	519			1,019		
February	11,071	8,071			8,571		
March	9,039	6,039			6,539		
April	7,861	4,861		4,546	5,361		
May	6,399	3,399		9,407	3,899		
June	5,451	2,451		12,806	2,951		3,284
July	3,605	605		15,257	1,105		6,235
August	3,117	117		15,862	617		7,340
September	1,430		1,570	15,979		1,070	7,957
October	1,056		1,944	14,389		1,444	6,887
November	1,446		1,554	12,445		1,054	5,443
December	1,586		1,414	10,891		914	4,389
1904.							
January	2,813		187	9,477	313		3,475
February	4,600	1,600		9,290	2,100		3,788
March	3,093	93		10,890	593		5,888
April	1,997		1,003	10,983		503	6,481
May	1,115		1,885	9,980		1,385	5,978
June	1,220		1,780	8,095		1,280	4,593
July	1,222		1,778	6,315		1,278	3,313
August	6,587	3,587		4,537	4,087		2,035
September	956		2,044	8,124		1,544	6,122
October	353		2,647	6,078		2,147	4,578
November	812		2,188	3,431		1,688	2,431
December	1,757		1,243	1,243		743	743
1905.							
January	5,599	2,599			3,099		
February	7,759	4,759		2,599	5,259		3,099
March	4,103	1,103		7,358	1,603		8,358
April	3,031	31		8,461	531		9,961
May	3,067	87		8,492	587		10,492
June	1,641		1,359	8,579		859	11,079
July	1,733		1,267	7,220		767	10,220
August	3,098	98		5,953	598		9,453
September	762		2,238	6,051		1,738	7,713
October	1,045		1,955	3,813		1,455	6,258
November	1,000		2,000	1,858		1,500	4,758
December	8,337	5,337			5,837		

15.979×2.625=42,000,000,000 cubic feet effective storage required to hold flowage on Tallapoosa River at 3,000 second-feet.

7.957×2.625=20,000,000,000 cubic feet effective storage required to hold flowage on Tallapoosa River at 2,500 second-feet.

TABLE No. 11.—*Tallapoosa Reservoir No. 1, Cherokee Bluff.*

[Reservoir capacity and cost.]

Height of dam (spillway height, in feet).	Flooded land (square miles).	Storage capacity (million cubic feet).	Total cost.	Cost per million cubic feet.
40	1.17	[1]		
60	5.43	1.840		
80	11.59	6.590		
90	15.86	10.000		
100	20.12	15.430	$1,086,000	$70.06
120	30.75	29.610	1,480,000	49.98
140	44.34	50.540	2,040,000	40.36
160	60.35	79.480	2,860,000	35.98
180	78.21	117.990	3,980,000	33.73
190	88.17	141.180	4,630,000	32.80

[1] Limit of draw-off.

Storage required to hold flow at 4,200 second-feet (mean annual discharge) for period of 1903, 1904, and 1905, 131,000,000,000 cubic feet (190–90).

Survey of 1909 extended to 160-foot dam. Storage above this height is from United States Geological Survey map.

TABLE No. 12.—*Tallapoosa Reservoir site No. 1.*

Capacity of reservoir required to hold flowage at reservoir Dam No. 1, as shown through critical period 1903, 1904, and 1905.

Flowage at reservoir dam (second-feet).	Billion cubic feet.			
	Effective storage required.	Addition per 100 second-feet.	Evaporation on reservoir.	Total capacity of reservoir required.
1,000	2.1	0.7	2	4.1
1,100	2.8	.8	2	4.8
1,200	3.6	.8	2	5.6
1,300	4.4	.8	2	6.4
1,400	5.2	.8	2	7.2
1,500	6	.8	2	8
1,600	6.8	.8	2	8.8
1,700	7.6	1	2	9.6
1,800	8.6	1.04	2	10.6
1,900	9.7	1.04	2	11.7
2,000	10.7	1.04	2	12.7
2,100	11.8	1.04	2	13.8
2,200	12.8	1.04	3.5	16.3
2,300	13.8	1.04	3.5	17.3
2,400	16.5	2.7	4	20.5
2,500	20.7	4.2	4	24.7
2,600	24.8	4.1	4	28.8
2,700	29	4.2	4	33
2,800	33.2	4.2	5	38.2
2,900	37.4	4.2	5	42.4
3,000	43.6	6.2	5	48.6
3,100	49.8	6.2	5	54.8
3,200	56	6.2	5	61
3,300	62.8	6.8	5	67.8
3,400	69.6	6.8	5	74.6
3,500	76.4	6.8	5	81.4
3,600	83.2	6.8	5	88.2

The above table was obtained in the same manner as the preceding table, by using each assumed constant amount of flowage, or it could be obtained from drawing No. 11. The evaporation was computed as previously stated for the Etowah Reservoir, account being taken of the rainfall on the reservoir.

TABLE No. 13.—*Tallapoosa Reservoir site No. 1.*

[Capacity of reservoir required for navigation alone to hold flowage at Montgomery, as shown through critical period 1903, 1904, and 1905.]

TALLAPOOSA RESERVOIR NO. 1 ACTING ALONE.

Flowage at Montgomery (second-feet).	Billion cubic feet.			
	Effective storage required.	Addition per 500 second-feet.	Evaporation on reservoir +5 per cent loss due to control.	Total capacity of reservoir.
2,500	1.1	2.6	2.0	3.1
3,000	3.7	3.1	2.2	5.9
3,500	6.8	3.5	2.3	9.1
4,000	10.3	3.6	2.5	12.8
4,500	13.9	3.8	4.2	18.1
5,000	17.7	4.1	4.9	22.6
5,500	21.8	4.5	5.1	26.9

TABLE No. 13.—*Tallapoosa Reservoir site No. 1*—Continued.

TALLAPOOSA RESERVOIR NO. 1 ACTING ALONE—Continued.

Flowage at Montgomery (second-feet).	Billion cubic feet.			
	Effective storage required.	Addition per 500 second-feet.	Evaporation on reservoir +5 per cent loss due to control.	Total capacity of reservoir.
6,000	26.3	4.3	5.3	31.6
6,500	30.6	4.4	5.5	36.1
7,000	35.0	4.6	6.7	41.7
7,500	40.6	5.0	7.0	47.6
8,000	45.6	4.7	7.3	52.9
8,500	50.3	9.7	7.5	57.8
9,000	60.0	16.3	8.0	68.0
9,500	76.3	20.1	8.8	85.1
10,000	96.4	....	10.6	107.0

TALLAPOOSA RESERVOIR NO. 1 ACTING IN CONJUNCTION WITH ETOWAH RESERVOIR, WHICH HOLDS MONTGOMERY AT 6,600 SECOND-FEET FLOWAGE.

6,600	....	....	....	....
7,000	3.4	4.8	2.2	5.6
7,500	8.2	4.2	2.4	10.6
8,000	12.4	5.4	4.1	16.5
8,500	17.8	6.0	4.9	22.7
9,000	23.8	11.8	5.2	29.0
9,500	35.6	19.8	6.8	42.4
10,000	55.4	....	7.8	63.2

TABLE No. 14.—*Tallapoosa Reservoir No. 1.—Effects of storage.*

[*Effects.*—Various storage capacities. Various methods of control. Various effects for power navigation (added to 6,600 second-feet due to Etowah Reservoir). Evaporation included in reservoir capacity. Column N-N gives discharge of Alabama River at Montgomery in second-feet. Line N-P gives discharge of Tallapoosa River at dam site No. 1, Cherokee Bluff, in second-feet. Required reservoir capacity for various combinations is given in billion cubic feet. This table is obtained from various combinations of drawings Nos. 10 and 12.]

DISCHARGE IN SECOND-FEET.

Alabama River.	Tallapoosa River.												
N	2,300	2,400	2,500	2,600	2,700	2,800	2,900	3,000	3,100	3,200	3,300	3,400	3,500 P
8,000	23.79	26.13	29.48	33.16	36.50	40.95	41.53	50.25	55.50	61.05	66.80	73.55	80.52
8,100	24.35	26.64	30.00	33.73	37.05	41.48	45.04	50.75	56.04	61.50	67.45	74.10	81.13
8,200	25.02	27.41	30.62	34.42	37.71	42.11	45.65	51.36	56.60	62.15	69.00	74.75	81.75
8,300	25.85	28.06	31.33	35.27	38.52	42.85	46.39	52.06	57.30	62.96	69.69	76.45	83.48
8,400	26.82	28.97	32.20	36.29	39.42	43.78	47.20	52.88	58.10	63.70	70.46	77.25	84.22
8,500	27.94	30.03	33.21	37.51	40.62	44.85	48.18	53.82	59.05	64.68	71.35	78.15	85.17
8,600	29.18	31.21	34.32	38.86	41.90	46.03	49.27	54.88	60.00	65.55	72.35	79.10	86.20
8,700	30.55	32.49	35.52	40.36	43.32	47.37	50.51	56.05	61.10	66.60	73.35	80.10	87.10
8,800	32.08	33.92	36.85	42.04	44.87	48.82	51.87	57.36	62.40	67.80	74.45	81.15	87.98
8,900	33.76	35.51	38.32	43.90	46.58	50.43	53.34	58.78	63.60	70.00	76.52	83.15	89.00
9,000	34.54	36.17	38.89	46.00	48.57	52.27	54.84	60.33	65.15	71.45	77.95	84.50	91.12
9,100	37.50	39.00	41.63	48.12	55.54	54.13	56.73	62.03	66.75	72.95	79.30	85.90	92.48
9,200	39.59	40.97	43.47	50.49	52.75	56.17	58.64	63.87	69.50	74.46	80.85	87.35	94.02
9,300	41.85	43.09	45.47	53.07	55.15	58.42	60.67	65.85	71.15	77.25	83.53	90.07	95.70
9,400	44.16	45.28	47.53	55.77	57.70	60.82	62.91	68.00	73.50	79.35	85.71	92.04	98.68
9,500	46.68	47.67	49.76	58.68	60.43	63.38	65.28	71.28	76.80	81.55	87.70	94.00	100.42
9,600	49.31	50.15	52.13	61.76	63.31	66.11	69.27	73.75	79.00	84.70	90.73	96.00	102.27
9,700	52.07	52.79	54.64	65.08	66.43	70.06	72.10	77.47	81.75	87.31	93.14	99.27	104.50
9,800	55.02	55.62	57.33	69.62	70.79	73.23	76.13	80.37	85.45	90.90	95.70	101.80	108.00
9,900	57.96	58.43	60.03	73.24	75.24	77.52	79.30	84.44	88.65	94.00	99.66	104.55	110.74
10,000	61.18	61.54	63.02	78.18	79.00	81.12	83.76	87.79	92.50	96.78	102.28	108.15	114.12
N	Reservoir capacity in billion cubic feet.												

Table No. 15.—*Distances, elevations, and drainage areas, Tallapoosa River.*

Miles above Milstead.	Drainage area (square miles).	Station.	United States geological datum elevation.
0.0	(3,620)	Milstead	
6.0	3,114	Tallassee Power Co. (below dam)	194.3
8.5		Upper end of pond	257.9
9.5	3,104	Montgomery Power Co. (below dam)	283.3
15.7		Upper end of pond	323.3
17.3	2,848	Reservoir Dam No. 1 (below dam)	342.0
39.3	(2,334)	Sturdevant	
48.7	1,986	Upper end of pond	490.0
	1,436	Reservoir Dam No. 2 (below dam, Blakes Ferry, Little Tallapoosa River).	680.0
		Crest of dam	790.0

Appendix J.

Report of Assistant Engineer D. M. Andrews.

Montgomery, Ala., *March 10, 1910.*

Sir: I have the honor to submit, in what follows, a report upon an examination and survey of the Coosa River, its tributaries, and the Tallapoosa River with a view to the improvement of the Coosa and Alabama Rivers by means of reservoirs upon their headwaters, together with an investigation of the coordination of navigation and power on these streams.

Nine estimates and five tables are submitted, as follows:

Estimate (*a*) Six-foot navigation without power, Maj. Cavanaugh's estimate, 1905, in round numbers.

Estimate (*b*) Six-foot navigation, six high dams, including substructures of power houses.

Estimate (*c*) Nine-foot navigation without power.

Estimate (*d*) Six-foot navigation and power with local storage only.

Estimate (*d*) I. Six-foot navigation and power with local and Etowah storage.

Table (*d*) II. Six-foot navigation and power, physical conditions as to power.

Table (*d*) III. Flowage with cumulative local storage.

Table (*d*) IV. Flowage with Etowah and cumulative local storage.

Table (*d*) V. Horsepower with cumulative local, and with Etowah and cumulative local storage.

Table (*d*) VI. Storage required at Tallapoosa Reservoir No. 1 to maintain a minimum flow at Montgomery of 8,000 second-feet combined with Etowah storage, and to furnish in addition the flow for power shown.

Estimate (*e*). Etowah Storage Reservoir, spillway at 870.

Estimate (*f*). Tallapoosa Storage Reservoir No. 1, spillway at elevation 470.

Estimate (*f*) I. Tallapoosa Storage Reservoir No. 2, spillway at elevation 790.

Estimate (*g*). Conasauga Storage Reservoir, spillway at elevation 1,110.

Estimate (*a*) is Maj. Cavanaugh's estimate, 1905, for 6-foot navigation, and is the most economical if power is not considered.

Estimate (*b*) is for 6-foot navigation, Dams 1, 2, 6, 7, 11, 12, 13, 14, 15, 16, 17, and 18 being replaced by six high dams for the development of power. The power-house substructure, being a part of the dam, is included in the cost of dam structures. The estimates for the remaining locks and dams remain as given in estimate (*a*).

Estimate (*c*) is arrived at by raising all locks and dams of estimate (*a*) 3 feet, except 1, 2, 6, and 7, which are replaced by high dams at 2 and 7.

Estimates (*d*), (*d*) I, and Table (*d*) II are self-explanatory.

The minimum flow of the Coosa River at Riverside, Ala., in 1904, the lowest recorded was 1,225 second-feet. The Riverside shortage curve, drawing No. 8, reduced from large scale drawing, gives the shortage in billions of cubic feet, after all losses have been deducted, required to maintain a given discharge in second-feet at Riverside during 1904. By means of this curve the increase in flow at each of the six power dams, due to cumulative storage at and above the dam, was found, assuming such increase the same as an equivalent storage above Riverside would provide there.

Table (*d*) III was prepared by adding the flow due to cumulative storage at each power dam to the 1904 low-water flow, and adding or subtracting the run-off between the dam and Riverside and deducting losses due to lockages and leakage.

Table (*d*) IV was prepared by adding the cumulative local storage at each dam to Etowah storage and taking the resulting flow from the curve, drawing No. 8, and then proceeding as in Table (*d*) III.

Table (*d*) IV, V, and estimates (*e*), (*f*), (*f*) I, and (*g*) are self-explanatory.

RESERVOIRS.

Reservoir dams.—The section or profile of the storage dams, drawing No. 13, is computed for a specific gravity of the material it is proposed to use of 2½. This figure assumes the mass of the dam composed of Cyclopean masonry, one-half concrete and one-half large derrick stone.

The specific gravity of the stone of which it is proposed to build the Etowah Dam has been determined, as was also the weight per cubic foot of the sand it is proposed to use in the concrete, and, on the assumption of one-half concrete and one-half large stone, the specific gravity of the mass of the dam was found to be 2½.

The resultants of the forces acting on the dam under the two assumptions that the water is at the crest and that the reservoir is empty are kept within the middle third until points are reached where the pressure per square foot at the down-stream face reaches 16,380 pounds, and at the up-stream face 20,480 pounds. Thence, down to the base, these limiting pressures are maintained.

Etowah Reservoir.—Estimate (*e*) gives the cost of the Etowah Reservoir, which is, in round numbers, $4,000,000. This reservoir will impound 42,000,000,000 cubic feet, equivalent to 30,000,000,000 cubic feet effective storage at Riverside for the year 1904.

It will be seen that the items of track revision, removal of industrial plants, revision of highways, removal and raising of bridges constitute $770,000 of the estimate. These structures might just as well have been placed outside the flooded area when built. The section of the State of Georgia in which the proposed reservoir is located is developing industrially, and this item of cost may be expected to grow with time at an increasing ratio.

An excellent spillway was found. It, together with the dam, is shown in plan and section on map No. 12, sheets A and B.

It is perhaps well to explain here that all maps referred to in this report are numbered as follows:

Map 9, Tallapoosa River, reservoir site No. 1.
Map 10, Tallapoosa River, reservoir site No. 2.
Map 11, Conasauga River Reservoir site.
Map 12, Etowah River Reservoir site.
Map 13, Coosa River.

Special sheets are given the letters of the alphabet after the proper map number.

In what follows these maps are referred to in the following order:

Etowah Reservoir, map 12.
Tallapoosa Reservoir No. 1, map 9.
Tallapoosa Reservoir No. 2, map 10.
Conasauga Reservoir, map 11.
Coosa River, map 13.

Map 12, sheets C and D, are topographical maps showing the location of levees on the Allatoona-Pumpkin Vine Creek divide, needed to prevent flow from the proposed reservoir into the Pumpkin Vine Creek Valley.

Map No. 12, sheet E, shows the proposed relocation of the W. & A. R. R. There are 60 to 70 trains daily over this division of the road, and it will therefore be more economical to change the location as shown than attempt to raise the track and roadbed under such conditions of heavy traffic. Map 12, sheet F, shows conditions in the vicinity of Canton, Ga., and the portion of the L. & N. R. R. and the industrial plants that will have to be moved out of the flooded area. Canton proper is on a hill, well above the level of the reservoir.

Tallapoosa Reservoir No. 1.—Drawing No. 14 is a graphical presentation of the storage capabilities of this reservoir for each foot height above 90 feet to 200 feet, and the corresponding cost of the reservoir.

Map No. 9, sheet A, is a map of the proposed dam and spillway sites. The dam is a reservoir dam and is shown in section on drawing No. 13. The spillway is a weir 500 feet long.

The estimate of the cost of the reservoir does not include a tailrace dam to be placed immediately below the reservoir dam and designed to maintain a head varying within the range of power wheels, as the level of the reservoir fluctuates. The same thing can, perhaps, be accomplished with draft tubes equipped with the necessary valves and by-passes.

Reference to Table No. (*d*) VI shows that a constant discharge of 2,500 second-feet for power and the needs of navigation require a storage of 29.48 billion cubic feet, which, combined with Etowah storage, will maintain a minimum flow of 8,000 second-feet at Montgomery. A reservoir of this capacity will require a dam 131 feet high (see drawing No. 14 and estimate (*f*)) and will cost $1,750,000.

Were navigation alone considered 15,000,000,000 cubic feet at Tallapoosa storage with that from the Etowah would afford a minimum flow of 8,000 second-feet at Montgomery. A reservoir of this capacity will require a dam 100 feet high and will cost $1,086,000.

Tallapoosa Reservoir No. 2.—Estimate (*f*) I gives the cost of the reservoir, site No. 2, near Blakes Ferry, and is in round numbers $1,340,000. This reservoir has a total storage capacity of 11,000,000,000 cubic feet and an effective capaicty of 9,000,000,000 cubic feet. The storage of this reservoir is not needed for navigation at present, but the site is available for development when the needs of navigation or power require the additional flow. Map No. 10, sheet A, shows the site of the proposed dam and spillway.

Conasauga Reservoir.—The cost of the Conasauga Reservoir is given in estimate (*g*), and is in round numbers $1,150,000. This reservoir will impound the entire discharge of the Conasauga and Jack Rivers, which is estimated to be 6,000,000,000 cubic feet, the equivalent of 4,000,000,000 cubic feet effective storage at Riverside, Ala., in 1904. Referring this storage to the shortage curve, drawing No. 8, and it is seen that it will supply a shortage in the 1904 flow of the Coosa River at Riverside of 1,000 second-feet; combined with cumulative local storage it will furnish a shortage flow of 400 second-feet at Dam 18; combined with cumulative local and Etowah storage it will furnish a shortage flow of 200 second-feet. Map 11. sheet A, is a topographical map of the dam and spillway site.

The estimated cost of the Conasauga Reservoir, previously given, is $1,150,000. It is estimated that the cost of 12.5 billion cubic feet additional storage at the Etowah Reservoir is $750,000. The addition to the Etowah Reservoir, therefore, costs $400,000 less than storage on the Conasauga, while the capacity of the former is 9,000,000,000 cubic feet effective storage as compared with 4,000,000,000 cubic feet at the latter.

Etowah and Tallapoosa storage will supply the present needs of navigation; therefore Conasauga storage need not be considered further until the demands of navigation on the upper Coosa and power on the Conasauga and Coosa Rivers justify its development.

Flood control.—The estimated maximum discharge of the Etowah River at the proposed dam site is 37,400 second-feet. If there were no pondage above the spillway, this discharge would raise the level above at once to 6.85 feet. But with pondage over the area of the reservoir the rise will be much slower, as shown on the upper discharge curve, drawing No. 15. The service pipes through the dam will, however, carry 9,400 second-feet, and the effect of the combined discharge through them and the spillway is shown on the lower curve. Theoretically the maximum heights of 6.85 and 5.75 feet under the two conditions would be reached only after an infinite number of days at the maximum rate of discharge; but practically they would be reached at the end of the eighth day, and the maximum flood would be delayed that length of time under the assumed condition that the level of the reservoir was at the sill of the spillway when the flood began.

The records, as far as they go, show that the maximum discharge has occurred only once, and then lasted only one day. Fortunately the records of the same flood at Rome, Ga., and Montgomery, Ala., are available, and the probable effect of the reservoir upon flood control at these places can be shown.

The watersheds of the Etowah, Oostanaula, Coosawattee, and Conasauga are near each other, and it is probable that any general rain, such as would produce a flood in the Coosa River, would occur simultaneously over their watersheds, and the floods from each would reach Rome about the same time; therefore the holding back of the flood from the Etowah would have a marked beneficial effect upon the intensity of the flood at Rome, as is shown below.

On December 29, 1901, the date of the greatest recorded flood on the Etowah River, the discharge at the proposed dam site reached the maximum of 37,400 second-feet. Assuming the valves in the proposed dam closed, then with this one-day maximum discharge into the reservoir the discharge from the spillway would have reached 8,300 second-feet, with a depth on the spillway of 2.83 feet, 2.94 billion cubic feet would have been held back, equivalent to a discharge of 34,070 second-feet for one day.

The discharge of the Coosa River at Rome during this flood was as follows: December 29, 1901, 40,402 second-feet; December 30, 58,000 second-feet; December 31, 64,420 second-feet; January 1, 1902, 54,940 second-feet. It is probable that the maximum flood from the Etowah reached Rome on December 31. Had the reservoir dam been built the maximum discharge at Rome would have been 30,350 second-feet instead of 64,420, and the gauge height would have been lowered from 32.6 to 15.8

feet, but the river would have fallen more slowly after the crest of the flood had passed.

The maximum rise at Montgomery, Ala., during the same flood was 46.1 feet at 3 p. m. January 1, 1902. It is estimated that the maximum discharge of the Etowah at the proposed dam site reached Montgomery in five days; that is, on January 3, 1902, when the gauge there read 42.5 feet, corresponding to a discharge of 133,300 second-feet. Deducting 34,070 second-feet for the flow that would have been held back by the proposed Etowah Reservoir, and the gauge at Montgomery would have been lowered from 42.5 feet to 33.4 feet.

Under conditions of flow prevailing during the flood under discussion, the proposed Etowah Reservoir would not have lowered the extreme height of the flood at Montgomery. It would, however, have caused a rapid fall.

In the following discussion of flood control by the proposed Tallapoosa Reservoir No. 1, a spillway length of 600 feet and 3,000 second-feet flow for power are assumed. The proposed spillway is a weir, and the height of the reservoir surface above the crest is computed by the Weisbach formula for unsubmerged dams. By means of this formula the curve, drawing No. 16, was constructed, h being the height of the reservoir surface above the crest of the spillway, Q the corresponding discharge over the weir, and D the sum of the discharges over the weir and through the power wheels.

For the purpose of this discussion the high water of December, 1901–January, 1902, is employed. This is the flood used in the discussion of flood control by the Etowah Reservoir.

On December 30, 1901, the date of maximum flood on the Tallapoosa River, the discharge at the proposed dam site was 27,170 second-feet. Reference to the curve, drawing No. 16, shows that the height of 4.88 feet would be reached only after an infinite number of days at the maximum rate of discharge; but, practically this height would be reached at the end of 11 days. As a matter of fact the maximum discharge extended over less than 1 day; but, assuming that it did extend over 1 entire day, then the reservoir would have reached a height of 1.37 feet above the crest of the proposed spillway, and would have impounded 1.96 billion cubic feet, corresponding to a discharge of 22,740 second-feet for 1 day.

As previously stated the maximum rise at Montgomery was 46.1 feet at 3 p. m., January 1, 1902, corresponding to a discharge there of 148,650 second-feet. It is probable that the maximum flood of December 30, 1901, at the proposed dam site, reached Montgomery at the time of maximum flood stage at the latter place; this being true, the flood discharge there would have been reduced by flood control at the Tallapoosa Reservoir to 125,910 second-feet, corresponding to a gauge height of 40 feet. The effect, therefore, of the proposed Tallapoosa Reservoir, under the assumed condition that the rise begins with the reservoir level at the crest of the spillway, will be to lower the height at Montgomery of a flood similar to that of January 1, 1902, 6.1 feet.

In the above discussion only one condition of control has been assumed, namely, that the respective reservoir levels were at the sill of the spillway of the Etowah Reservoir and at the crest of the spillway of the Tallapoosa Reservoir when the flood began, and that the maximum flow into the reservoirs continued during one day. Had the levels of the reservoirs been below the sill and crest of the spillways, the flood control would have been greater. Had it been above, the control would have been less. The greater the number of days duration of the maximum discharge, the less the effect of control becomes.

The general effect will be to lessen the height of floods and to lengthen their duration.

Minerals and underground flow.—The great "Cartersville fault" passes south of the proposed dam site, and does not enter the proposed reservoir area at all.

The fault marks a distinct division between the Paleozoic on the south and the Archean on the north. The minerals of importance, except marble, are found in the Paleozoic. The marble, and some small deposits of iron ore within the flooded area lie well above the reservoir level.

Investigation of wells and springs in this vicinity indicates that their sources of supply are from local surface seepage. This, together with the crystalline character of the rock in the proposed flooded area precludes the probability of underground flow from the reservoir.

The rocks of the flooded areas of the proposed Tallapoosa and Conasauga Reservoirs are crystalline in character, and loss from underground flow need not be expected.

Silting.—Silting at existing dams on the Etowah, Tallapoosa, and Connasauga Rivers was carefully investigated, some of the dams having been in existence for 70 years. No evidences of the movement of heavy material were found. Only light loam and clay held in suspension had been deposited. It was shown in your preliminary report that a period of 6,000 years would be required for reservoirs on these streams to fill with such material.

EFFECT OF ETOWAH STORAGE UPON THE NAVIGATION OF THE COOSA RIVER.

The mean slope of the Coosa River from Rome, Ga., to Gadsden, Ala., is 1: 9,800. There is no obstruction in this part of the river at which a slope of 1:2,000 can not be secured by means of works of regulation, except at Horseleg Shoals, where it is proposed to provide a lock and dam.

A minimum flow of 4,000 second-feet maintained at Riverside will result in a minimum flow at Rome of 3,500 second-feet. This flow on a slope of 1: 2,000 will maintain channel depths and widths as shown below:

Depth.	Width.
Feet.	*Feet.*
4	310
5	210
6	157
7	121

It is thus seen that 4-foot navigation can be easily secured, and if at any time in the future the demands of navigation require 6 feet, the passage from one depth to the other can be made by further contraction, far more economically than by raising locks and dams, if such structures had been already built for 4-foot navigation.

A comparison of the cost of improving this section of the river for 4-foot navigation by means of locks and dams and by Etowah storage and regulation works is given below:

Items of improvement.	Slack-water navigation, locks and dams.	Open-river navigation, Etowah storage.
7.5 locks and dams at $241,000	$1,807,500	
Operation and maintenance, $5,000 each per year, capitalized at 3 per cent	1,250,000	
One lock and dam at Horseleg Shoals		$241,000
Operation and maintenance, $5,000 per year, capitalized at 3 per cent		167,000
Regulation works		100,000
Maintenance, $20,000 per year, capitalized at 3 per cent		667,000
Total	3,057,500	1,175,000

The improvement for open-river navigation by means of Etowah storage and regulation works is $1,882,500 more economical than the improvement for slack-water navigation by means of locks and dams. This estimate assumes that the cost of the Etowah Reservoir is charged to the improvement of the Alabama River, as proposed in estimates that follow.

EFFECT OF ETOWAH STORAGE UPON THE NAVIGATION OF THE ALABAMA RIVER.

Etowah storage and storage at the power dams on the Coosa River, with the natural flow of the Alabama River, will supply a minimum flow at Montgomery of 6,600 second-feet. Such a flow will maintain a channel depth and width of 7 feet and 355 feet, respectively, on a slope of 1: 5,000.

The low-water flow of the Alabama River in 1904 was 2,100 second-feet. With such a discharge, 6-foot navigation is impracticable (see Table 3, with your preliminary report), and it is believed that 4-foot navigation the year round is impracticable also. Therefore a project for the improvement of the Coosa and Alabama Rivers is a choice between slack-water navigation throughout the length of these streams and open-river navigation, with storage on their headwaters and locks and dams, with slack-water navigation over the rapids between Gadsden and Wetumpka.

The zero of the Wetumpka gauge, mean low water, is 115.32 feet above mean sea level at Mobile. Dividing this into equal steps of 12 feet each, gives 9.61 locks and dams required from tidewater near Mobile to Wetumpka. Basing the cost of each lock and dam on the cost of similar structures for 6-foot navigation on the lower Warrior River, a stream of the general character of the Alabama, and each lock and dam will cost $700,000, or a total cost for 9.61 locks of $6,727,000.

In order to present a clear comparison between the cost of the two projects, the following table has been prepared, all fixed charges appearing capitalized at 3 per cent:

Items of improvement.	Slack-water navigation, locks and dams, cost.	Open-river navigation, Etowah storage, cost.
Slack-water improvement, Coosa River, Rome to Gadsden, 7.5 locks and dams	$1,807,500	
Estimate (*b*)	12,753,000	
9.61 locks, Wetumpka to Mobile	6,727,000	
Operation and maintenance, 21.11 locks and dams, $5,000 each per year; 10 locks, at $3,000 per year, capitalized at 3 per cent	4,518,333	
Etowah Reservoir		$4,000,000
Operation and maintenance, $10,000 per year, capitalized at 3 per cent		333,333
Open-river navigation, Rome to Gadsden, including lock and dam at Horseleg Shoals		1,007,667
Estimate (*b*)		12,753,000
Operation and maintenance, 9 locks and dams, at $5,000, and 10 locks, at $3,000 per year, capitalized at 3 per cent		2,500,000
Regulation works, Alabama River		1,000,000
Maintenance, $100,000 per year, capitalized at 3 per cent		3,333,333
Total	25,805,833	24,927,333

Economy of open-river navigation with Etowah storage, $878,500.

EFFECT OF TALLAPOOSA AND ETOWAH STORAGE UPON THE NAVIGATION OF THE ALABAMA RIVER.

The proposed storage on the Etowah and Tallapoosa Rivers will maintain a minimum flow at Montgomery of 8,000 second-feet. Reference to Table No. 3, with your preliminary report, shows that such a flow for a channel depth of 7 feet will require channel widths as follows: Slope 1:5,000, width 460 feet; Slope 1:2,000, width 300 feet.

It has been shown that the cost of improving the Coosa and Alabama Rivers for 6-foot navigation by storage on the Etowah is $878,500 more economical than their improvement for slack-water navigation by means of locks and dams throughout their length. As Tallapoosa storage only affects the navigation of the Alabama River, a comparison of the cost of 6-foot navigation on this stream by means of works of regulation with and without Tallapoosa storage, given in the following table, shows the relative economy of each project, it being assumed in each case that Etowah storage is available and all fixed charges being capitalized at 3 per cent:

Items of improvement.	6-foot navigation.	
	Works of regulation, cost.	Tallapoosa storage, cost.
Works of regulation	$1,000,000	
Maintenance, $100,000 per year, capitalized at 3 per cent	3,333,333	
Tallapoosa reservoir		$1,750,000
Operating and maintenance, $10,000 per year, capitalized at 3 per cent		333,333
Works of regulation		500,000
Maintenance of channel, $30,000 per year, capitalized at 3 per cent		1,000,000
Total	4,333,333	3,583,333

Economy of Tallapoosa storage, $750,000.

The preceding estimates are based on very complete data and on current prices in the vicinity of the proposed improvements, except the estimates for works of regulation and maintenance of channel. These latter are matters of judgment and are believed to be ample.

Summing up, the comparative cost of 6-foot slack-water navigation on the Coosa and Alabama Rivers without storage is $25,805,833. With slack-water navigation over the rapids between Wetumpka and Gadsden on the Coosa and open-river navigation between Rome and Gadsden and on the Alabama, with Etowah and Tallapoosa storage, the comparative cost is $24,177,333. The economy of the improvement with Etowah and Tallapoosa storage is therefore $1,628,500.

In the preceding discussion the estimates are all comparative; that is, the fixed charges are included, capitalized at 3 per cent. In the following statement is given the total estimated cost of the improvement of the Coosa and Alabama Rivers, in which the capitalized fixed charges are omitted. The estimate is for Etowah and Tallapoosa storage, and six power dams on the Coosa, and the development of power at the reservoir dam on the Tallapoosa.

Etowah Reservoir, estimate (*e*)		$4, 000, 000
Lock and dam at Mayo's bar		241, 000
Locks and dams, Gadsden to Wetumpka, estimate (*b*)		12, 763, 000
Tallapoosa Reservoir, estimate (*f*)		1, 750, 000
2 equalizing dams		320, 000
		19, 074, 000
Projects already approved by department:		
Lock and dam at Mayo's bar	$241, 000	
Lock and Dam 4	282, 000	
Dam 5	134, 000	
		657, 000
To complete improvement for 6-foot navigation		18, 417, 000

NAVIGATION AND POWER ON THE COOSA RIVER.

In the cost of the 6 high dams, estimate (*b*), is included the cost of power-house substructures, for, if power is to be developed at these dams, even at some future day, these substructures should be built now as a part of the dam; to omit them would entail an enormous additional expense when the power at the dams is developed.

The following statement gives a comparison of the cost for 6-foot navigation alone and in cooperation with power for the Gadsden-Wetumpka section.

Navigation alone.

Estimate (*a*)	$10, 025, 000
Operation and maintenance 20 locks and dams at $5,000 per year, capitalized at 3 per cent	3, 333, 333
Total	13, 358, 333

Navigation and power.

Estimate (*b*)	12, 753, 000
Operation and maintenance 8 locks and dams, at $5,000 per year, capitalized at 3 per cent	1, 333, 333
10 locks, at $3,000	1, 000, 000
Total	15, 086, 333
Excess of cost of navigation and power over navigation alone	1, 728, 000

If power builds the power dams, including substructures of power houses, then estimate (*b*) becomes $7,177,000 and conditions are reversed; the excess of cost for navigation alone over power and navigation becomes $3,648,000.

POWER.

The estimated average cost of 10-hour power for 196,908 horsepowers, primary and secondary, developed by the natural flow of the Coosa River and local storage at the six power dams, including the cost of dams, substructures and superstructures of power houses; hydroelectric equipment, including switchboards, step-up and step-down stations, transmission lines, loss of interest during construction, engineering and legal expenses and equalizing dam is $104.74 per horsepower.

The secondary power is assumed as equal to the primary power, and as being three-fourths as effective, this assumption being well within the requirements of good practice.

Secondary power, if it can find a market at all, will probably sell for $5 less per horsepower per year than primary power. Referring to Table (*d*) V, Column IV, it is seen that with Etowah storage the 98,354 secondary power in Column II becomes primary, and is therefore increased $5 per horsepower per year in value at no additional cost to power.

Etowah storage adds an additional primary power, see Table (*d*) V, Column V, of 25,477 horsepowers. It is estimated that this power delivered will cost for installation $58.04 per horsepower, or $46.70 less than the original installation. The value of the right to utilize power that can be produced at this cost, which is about 20 per cent of the average cost for development of hydroelectric power in the United States, is very great.

The proposed dam, Tallapoosa Reservoir No. 1, 131 feet high, will develop fifty thousand 10-hour delivered primary horsepowers with a constant flow of 2,500 second-feet.

The head used in computing this power is the mean of the heads when the reservoir is full, and when drawn down to within 90 feet of the bottom. The lower head will be reached only in a cycle of years such as were 1903, 1904, and 1905, and when this occurs the additional flow for navigation will compensate for the loss of head.

EQUALIZING DAMS.

The estimates and discussions of power in this report are based on 10-hour power; that is, that power from the dams will be delivered only during 10 hours each day, and that the flow of the Coosa and Tallapoosa Rivers will be held back 14 hours of the 24 during periods of minimum flow. This would result in a discharge 2.4 times greater than the minimum during 10 hours of each day, and an entire cessation of flow the remainder of the time. It is thus obvious that equalizing dams below the power dams are essential to the proper control of the flow of the Alabama River.

It is proposed to make Dam 19 an equalizing dam on the Coosa River, at an additional estimated cost of $220,000. In order to prevent excessive flood heights it was necessary to lengthen the spillway 300 feet in adapting the dam to the purpose of an equalizing dam. A large part of the additional cost is due to this increase in length.

It is estimated that an equalizing dam on the Tallapoosa below the falls at Tallassee will cost $100,000.

Canals around high dams.—Estimates for canals around the power dams at proposed sites 12, 14, 15, and 18 are included in the estimates for locks at those sites in estimates (*b*), (*d*), and (*d*) I. It is not considered safe for a large tow to approach near one of the power dams, but with the canals that have been provided for, a tug with a tow has ample distance in which to "back up" should it miss the entrance to the canal. Long upper guide piers have been provided for at sites 2 and 7. Map 13, sheets A and B, shows the locations of the proposed canals around Dams 12 and 18.

Foundations.—Borings for foundations have been made at dam sites Nos. 12, 14, and 15, and partial borings at site No. 18. At all these places perfect foundations have been found, as shown on cross sections of sites 12, 14, and 15, map No. 13, sheets C, D, and E. While no borings have been taken at site No. 7, the outcropping rock there gives every indication of excellent foundation. Past experience with foundation at site No. 2 has shown perfect foundation there.

FUTURE NEEDS OF NAVIGATION.

Considerations of economy require that the future needs of navigation be foreseen and provided for in the study of any project for the improvement of the Coosa and Alabama Rivers. It is reasonable to assume that, as the country develops and population increases, our rivers will be more and more used as lines of transportation and greater depths will be called for. This is especially true of the Coosa and Alabama Rivers, which, penetrating the mining and manufacturing section of the South as they do and emptying into the Gulf, are destined to become important feeders to the traffic of the Panama Canal.

Slack-water navigation by means of locks and dams gives an assured depth the year round, but, on the other hand, the change to a greater depth of navigation requires the raising of dams and the enlargement of locks at a cost perhaps little less than the cost of the original improvement; and, then, too, in an alluvial stream, such as is the Alabama, it is probable that in time the pools between dams will fill and require constant dredging to maintain a channel through them.

A reservoir of 130,000,000,000 cubic feet capacity on the Tallapoosa River at the proposed site No. 1 will impound the mean annual flow of the Tallapoosa of 1901 to 1908, inclusive. A reservoir of this capacity (see drawing No. 14) will require a dam 190 feet high and will cost $4,800,000, including $150,000 for an equalizing dam. Such a reservoir will afford an effective storage of 120,000,000,000 cubic feet, which will supply 3,500 second-feet constant flow for power, and, with Etowah storage, will furnish a minimum flow at Montgomery of 10,500 second-feet and 9-foot navigation. This is the limit of storage development. But with the ultimate storage constant, the figures for navigation and power can be varied either way; that is, if the flow for power is decreased, the flow for navigation increases, and vice versa.

The lock and dam numbers referred to throughout this report are the numbers as used in Maj. Cavanaugh's report of 1905.

Respectfully submitted.

D. M. Andrews, *Assistant Engineer.*

Capt. H. B. Ferguson,
Corps of Engineers.

Estimate (*a*).—*Six-foot navigation without power.*

[Maj. Cavanaugh's report, 1905, in round numbers.]

Lock No.	Locks (cost).	Dams (cost).	Channel excavation (cost).	Flooded lands (cost).	Total.
1	$100,000	$75,000	$71,000		$246,000
2	111,000	21,000	6,000		138,000
3	413,000	3,000	4,000		420,000
4	282,000	12,000	224,000	$24,000	542,000
5	132,000	114,000	31,000	9,000	286,000
6	239,000	143,000	19,000	23,000	424,000
7	168,000	105,000	41,000	5,000	319,000
8	203,000	87,000		4,000	294,000
9	267,000	96,000	18,000	6,000	387,000
10	257,000	209,000		32,000	498,000
11	303,000	259,000		20,000	582,000
12	681,000	368,000		6,000	1,055,000
13	559,000	368,000		5,000	932,000
14	487,000	235,000		4,000	726,000
15	649,000	265,000		9,000	923,000
16	348,000	274,000	5,000	2,000	629,000
17	345,000	157,000		3,000	505,000
18	313,000	133,000		2,000	448,000
19	416,000	148,000		2,000	566,000
20	28,000	31,000	46,000		105,000
Total	6,301,000	3,103,000	465,000	156,000	10,025,000

Estimate (*b*).—*Six-foot navigation, 6 high dams, including substructures of power houses.*

Lock No.	Locks (cost).	Dams (cost).	Channel excavation (cost).	Flooded lands (cost).	Total.
1 [1]					
2	$267,000	$410,000	$16,000	$28,000	$721,000
3	413,000	3,000	4,000		420,000
4	282,000	12,000	224,000	24,000	542,000
5	132,000	114,000	31,000	9,000	286,000
6 7	369,000	404,000	41,000	66,000	880,000
8	203,000	87,000		4,000	294,000
9	267,000	96,000	18,000	6,000	387,000
10	257,000	209,000		32,000	498,000
11 12	837,000	1,483,000		44,000	2,364,000
13 14	756,000	926,000		2,000	1,684,000
15	674,000	754,000		14,000	1,442,000
16 17 18	942,000	1,599,000		23,000	2,564,000
19	416,000	148,000		2,000	566,000
20	28,000	31,000	46,000		105,000
Total	5,843,000	6,276,000	380,000	254,000	12,753,000

[1] Out.

ESTIMATE (*c*).—*Nine-foot navigation without power.*

Lock No.	Locks (cost).	Dams (cost).	Channel excavation (cost).	Flooded lands (cost).	Total.
1 [1]					
2	$174,000	$188,000	$66,000	$28,000	$456,000
3	518,000	30,000	4,000	2,000	554,000
4	314,000	37,000	224,000	33,000	608,000
5	144,000	148,000	31,000	9,000	332,000
6 [1]					
7	394,000	375,000	41,000	73,000	883,000
8	217,000	116,000		4,000	337,000
9	283,000	108,000	18,000	6,000	415,000
10	275,000	240,000		32,000	547,000
11	323,000	297,000		19,000	639,000
12	707,000	405,000		6,000	1,118,000
13	585,000	405,000		5,000	995,000
14	510,000	266,000		3,000	779,000
15	675,000	292,000		9,000	976,000
16	368,000	313,000	5,000	2,000	688,000
17	365,000	182,000		3,000	550,000
18	333,000	153,000		1,000	487,000
19	439,000	166,000		2,000	607,000
20	43,000	34,000	46,000		123,000
Total	6,667,000	3,755,000	435,000	237,000	11,094,000

[1] Out.

ESTIMATE (*d*).—*Six-foot navigation and power with local storage only.*

Lock No.	Locks (cost).	Dams [1] (cost).	Power [2] (cost).	Channel excavation (cost).	Flooded lands (cost).	Total.
1 [3]						
2	$267,000	$410,000	$674,000	$16,000	$28,000	$1,395,000
3	413,000	3,000		4,000		420,000
4	282,000	12,000		224,000	24,000	542,000
5	132,000	114,000		31,000	9,000	286,000
6	369,000	404,000	769,000	41,000	66,000	1,649,000
7						
8	203,000	87,000			4,000	294,000
9	267,000	96,000		18,000	6,000	387,000
10	257,000	209,000			32,000	498,000
11	837,000	1,483,000	1,638,000		44,000	4,002,000
12						
13	756,000	926,000	1,354,000		2,000	3,038,000
14						
15	674,000	754,000	1,309,000		14,000	2,751,000
16						
17	942,000	1,599,000	1,830,000		23,000	4,394,000
18						
19	416,000	148,000			2,000	566,000
20	28,000	31,000		46,000		105,000
Total	5,843,000	6,276,000	7,574,000	380,000	254,000	20,327,000

[1] Cost of power house, substructure included.
[2] Cost of power house, superstructure, and complete hydroelectric equipment, except transmission line.
[3] Out.

ESTIMATE (*d*) I.—*Six-foot navigation and power with local and Etowah storage.*

Lock No.	Locks (cost).	Dams [1] (cost).	Power [2] (cost).	Channel excavation (cost).	Flooded lands (cost).	Total.
1 [3]	....	....	....	....	....	....
2	$267,000	$410,000	$856,000	$16,000	$28,000	$1,577,000
3	413,000	3,000	....	4,000	....	420,000
4	282,000	12,000	....	224,000	24,000	542,000
5	132,000	114,000	....	31,000	9,000	286,000
6, 7	369,000	404,000	957,000	41,000	66,000	1,837,000
8	203,000	87,000	....	....	4,000	294,000
9	267,000	96,000	....	18,000	6,000	387,000
10	257,000	209,000	....	....	32,000	498,000
11, 12	837,000	1,483,000	1,840,000	....	44,000	4,204,000
13, 14	756,000	926,000	1,520,000	....	2,000	3,204,000
15	674,000	754,000	1,445,000	....	14,000	2,887,000
16, 17, 18	942,000	1,599,000	1,985,000	....	23,000	4,549,000
19	416,000	148,000	....	....	2,000	566,000
20	28,000	31,000	....	46,000	....	105,000
Total	5,843,000	6,276,000	8,603,000	380,000	254,000	21,356,000

[1] See footnote estimate (*d*). [2] See footnote estimate. [3] Out.

TABLE (*d*) II.—*Six-foot navigation and power, physical conditions as to power.*

Lock No.	Lift, low water.	Low water.		High water.		Length of spillway.		Height over all.
		Upper pool.	Lower pool.	Upper pool.	Lower pool.	Total.	Clear.	
2	26	527.0	501.0	533.0	518.0	1,400	1,120	....
7	29	475.0	446.0	485.0	464.0	980	980	10.0
12	58	410.0	352.0	420.5	366.0	1,160	930	10.5
14	55	352.0	297.0	362.5	318.5	900	900	10.5
15	43	297.0	254.0	310.0	270.0	850	680	13.0
18	64	254.0	190	267.0	209.0	850	680	13.0

TABLE (*d*) III.—*Flowage with cumulative local storage.*

Lock No.	Effective power head.	Low-water flow, second-feet.		14-hour pondage.		Local storage remaining.		Add to flow account of local storage.	Minimum flow with cumulative local storage (1904).
		Normal.	Effective.	Feet depth.	Millions cubic feet.	Feet depth.	Millions cubic feet.		
2	26	1,170	1,063	0.33	55	7.67	1,305	500	1,563
7	29	1,298	1,173	....	....	....	....	500	1,673
12	63	1,453	1,313	0.41	78	9.59	1,821	800	2,113
14	50	1,474	1,338	....	....	....	....	800	2,138
15	42	1,554	1,432	0.84	82	4.16	405	855	2,287
18	63	1,568	1,415	0.80	86	5.20	557	945	2,360

TABLE (*d*) IV.—*Flowage with Etowah and cumulative local storage.*

Lock No.	Effective power head.	Low-water flow, second-feet.		14-hour pondage.		Local storage remaining.		Add to flow account of cumulative local and Etowah storage	Minimum flow with cumulative local and Etowah storage (1904).
		Normal.	Effective.	Feet depth.	Millions cubic feet.	Feet depth.	Millions cubic feet.		
2	26	1,170	1,063	1.20	206	6.80	1,155	2,909	3,970
7	29	1,298	1,173	...	...	...	...	2,991	4,164
12	63	1,453	1,313	1.30	246	8.70	1,652	3,434	4,747
14	50	1,474	1,338	...	...	...	...	3,462	4,800
15	42	1,554	1,432	2.00	261	3.00	217	2,619	5,051
18	63	1,568	1,415	2.40	266	3.60	377	3,705	5,120

TABLE (*d*) V.—*Horsepower with cumulative local and with Etowah and cumulative local storage.*

[Coosa River.]

Dam No.	Efficiency, per cent.	Cumulative local storage, 1904.		Cumulative local and Etowah storage.	Increase on account of Etowah storage.	
		I.	II.	III.	IV.	V.
		Primary, 10-hour, delivered.	Secondary, 10-hour, delivered.	Primary, 10-hour, delivered.	Secondary, made primary, 10-hour, delivered.	Additional, 10-hour, primary delivered.
2	50	6,650	6,650	16,891	6,650	3,591
7	60	7,939	7,939	19,760	7,939	3,882
12	64	23,235	23,235	52,200	23,235	5,730
14	62	18,076	18,076	40,582	18,076	4,430
15	63	16,503	16,503	36,450	16,503	3,444
18	64	25,951	25,951	56,302	25,951	4,400
Total	...	98,354	98,354	222,185	98,354	25,477

TABLE (*d*) VI.—*Required reservoir capacity to maintain flowage as shown 1903, 1904, and 1905.*

[Riverside, 4,600; Montgomery, 8,000. Storage expressed in billions of cubic feet.]

Constant flowage required for power.	Storage required for power.	Additional storage required for navigation.	Total required for power and navigation.
3,000	48.6	1.65	50.25
2,900	42.4	2.13	44.53
2,800	38.2	2.75	40.95
2,700	33.0	3.50	36.50
2,600	28.8	3.98	33.16
2,500	24.7	4.78	29.49

ESTIMATE (*e*).—*Etowah River storage reservoir.*

[Spillway at elevation 870. Estimate of cost of project.]

	Unit price.	Total.
338,000 cubic yards Cyclopean concrete masonry	$4.95	$1,673,100.00
16,500 cubic yards concrete in core walls	6.00	99,000.00
7,500 acres of submerged land	8.00	60,000.00
12,800 acres of submerged land	25.00	320,000.00
8,500 acres of submerged land	40.00	340,000.00
7.5 miles of W. & A. and L. & N. R. R. track revision	52,000.00	390,000.00
265,000 cubic yards excavation in spillway	.50	132,500.00
23,000 cubic yards rock excavation in foundation	2.00	46,000.00
7,400 cubic yards earth excavation in core wall	1.00	7,400.00
191,000 cubic yards earth embankments	.30	57,300.00
650,000 pounds cast-steel discharge pipe	.06	39,000.00
Twelve 72-inch hydraulic valves	1,000.00	12,000.00
4 miles of material track	20,000.00	80,000.00
Protection, removal, or purchase of industrial plants		200,000.00
Revision of roads, new roads, bridges, etc		180,000.00
Engineering and contingencies, 10 per cent		363,630.00
Total		3,999,930.00

ESTIMATE (*f*).—*Tallapoosa storage reservoir No. 1.*

[131-foot dam. Elevation of spillway, 470; top of dam, 480.]

	Unit cost.	Total.
138,800 cubic yards Cyclopean concrete masonry	$6.25	$867,500.00
24,100 acres submerged lands	20.00	482,000.00
11,000 cubic yards rock excavation in foundation	2.00	22,000.00
127,200 cubic yards earth excavation in foundation	.75	95,400.00
Damage to industrial plants		45 000.00
Revision of roads, new roads, bridges, etc		55,000.00
300,000 pounds cast-steel discharge pipe	.06	18,000.00
Six 72-inch hydraulic valves	1,000.00	6,000.00
Engineering and contingencies, 10 per cent		159,090.00
Total		1,749,990.00

ESTIMATE (*f*) I.—*Tallapoosa River storage reservoir, Dam No. 2.*

[Elevation of spillway, 790; top of dam, 800.]

	Unit price.	Total.
165,500 cubic yards Cyclopean concrete masonry	$5.88	$973,140
6,900 acres of submerged lands	15.00	103,500
25,650 cubic yards rock excavation in foundation	2.00	51,300
8,000 cubic yards earth excavation for embankments	.25	2,000
300,000 pounds cast-steel discharge pipe	.06	18,000
Six 72-inch hydraulic valves	1,000.00	6,000
Damage to industrial plants		10,000
Cost of bridges, changes in roads, etc		50,000
Engineering and contingencies, 10 per cent		121,394
Total		1,335,334

ESTIMATE (*g*).—*Conasauga River storage reservoir.*

[Elevation of spillway, 1,110; top of dam, 1,120. Estimate of cost of project.]

	Unit cost.	Total cost.
173,400 cubic yards Cyclopean concrete masonry	$4.80	$832,320
1,700 acres of submerged land	40.00	68,000
72,800 cubic yards excavation in spillway	.60	43,680
12,800 cubic yards rock excavation in spillway	1.00	12,800
200,000 pounds steel discharge pipe	.06	12,000
Four 72-inch hydraulic valves	1,000.00	4,000
Revision of roads, new roads, etc		20,000
Damage to lumber company's railway		50,000
Engineering and contingencies, 10 per cent		104,280
Total		1,147,080

Appendix K.

Letter of Coosa River Improvement Association.

Coosa River Improvement Association,
Gadsden, Ala., December 10, 1909.

Dear Sir: I hand you herewith various resolutions, pledges, and statements as to commerce that may be considered absolutely sure immediately upon completion of the project for opening the Coosa River from Rome to the Gulf.

Very respectfully,

W. P. Lay, *President.*

Capt. H. B. Ferguson,
Corps of Engineers.

Letter of Mr. J. R. Cantrell.

City Clerk's Office,
Rome, Ga., November 27, 1909.

This is to certify that at a regular meeting of the City Council of Rome, Ga., held on November 8, 1909, a formal resolution was passed commending the agitation looking toward the opening of the Coosa River to navigation from Rome to the Gulf of Mexico, and pledging itself to construct and maintain adequate wharf and wharf facilities on the river front in Rome on the property owned by the city and now used as a wharf so soon as the United States Government should improve the Coosa River with a through channel to the Gulf.

To the above intent the city council pledges the good faith of the city, agreeing to erect and maintain modern wharf or wharves, well equipped, using such appliances, conveyors, and elevators as are approved and as will best facilitate the handling of commerce at said wharves and to connect with the same by electric or steam railways for the handling of freights.

J. R. Cantrell, *Clerk of Council.*

Letter of Manufacturers and Merchants' Association of Floyd County, Ga.

Manufacturers and Merchants' Association of Floyd County, Ga.,
Rome, Ga., November 27, 1909.

Dear Sir: We realize that the growth and progress of Rome would be very materially benefited by the opening of the Coosa River from Rome to the Gulf of Mexico.

The present restricted mileage of the river, on which navigation is impossible, necessarily restricts the commerce that can be profitably carried on the river. We can not figure where investment in steamers and barges on the Coosa under the present conditions would prove profitable to investors, but we do see that it would be very profitable, owing to the assured large volume of business in case the channel is opened for through navigation to the Gulf.

We, the undersigned, do therefore agree and propose that at such time as the channel is opened for through navigation from Rome to Mobile, Ala., we will build or cause to be built, and operate or cause to be operated, a packet line of at least two steamboats and at least five barges.

J. A. Rounsaville.
Cary J. King.
J. N. King.
H. S. McCleskey.

Mr. W. P. Lay,
President Coosa River Development Association, Gadsden, Ala.

Letter of Rome & Northern Railroad Co.

Rome & Northern Railroad Co.,
Rome, Ga., November 30, 1909.

Dear Sir: We are smelting at our furnace 100 tons of pig iron a day. In case the Coosa River is opened to a depth of 6 feet from Rome to Mobile, no doubt that half of this pig iron at least will go to Mobile by water.

It is my understanding that the opening of this river will develop an immense coal field in Alabama. In the event this is done we will also use about 60,000 tons per year of this coal. In addition to the above we are owners of a large tract of timber which we will be glad to ship by water if the facilities are such as will justify it. We are also the heaviest buyers of raw material and merchandise in this section and would be glad to have as much of our supply as practicable consigned by water.

Our interest here represents a large furnace, the R. G. Peters Mining Co., the Rome & Northern Railroad, and two sawmills. We are adding to this every month, and if modern wharves are constructed at Rome, we will of course be glad to connect our railroad to them.

Yours, very respectfully,

Rome & Northern Railroad Co.,
By H. H. Shackleton.

Mr. W. P. Lay,
President Coosa River Development Association, Gadsden, Ala.

Resolution of the City Council of Gadsden, Ala.

Whereas the benefits to be received by the people of the city of Gadsden and surrounding country, as well as by the people living all along the Coosa and Alabama Rivers, in the proposed improvement of said rivers for navigation to the Gulf, are manifold and well understood: Therefore be it

Resolved by the mayor and board of aldermen of the city of Gadsden, That it is the declared purpose of the city, and it hereby pledges itself, to construct and maintain adequate wharf and wharf facilities on the river front in Gadsden on the property owned by it, and now used by it as a wharf, so soon as the United States Government shall progress with said river improvement to that extent that a through channel is available, and that the city will forever erect and maintain adequate wharf and wharf facilities to meet the demands of commerce on said river, the good faith of the city being hereby pledged to erect and maintain modern, well-equipped wharves, using such appliances, conveyers, and elevators as are approved and as will best facilitate the handling of commerce at said wharf, and to connect with the same electric or steam railway, or both.

I, R. M. Wilbanks, city clerk of the city of Gadsden, Ala., hereby certify that the foregoing attached is a true and correct copy of a resolution adopted by the city council in session November 19, 1909.

I hereunto set my hand and affix the city seal, this the 26th day of November, 1909.

R. M. Wilbanks, *City Clerk.*

Letter of the Wilpicoba Clay Works.

Wilpicoba Clay Works,
Ragland, Ala., November 25, 1909.

Dear Sir: In regard to opening the Coosa River to through navigation to the Gulf, which is the splendid purpose of your association, allow me to assure you of my hearty cooperation in any way that I may be of assistance in influencing this improvement. I am engaged in the manufacture of vitrified paving and commercial brick, and the need of water transportation for the marketing of our products is a serious daily encounter with us. Our only outlet from Ragland is one railroad, the Seaboard Air Line, and although we are making a superior grade of brick, and because of the juxtaposition of our fuel and shale supplies are enabled to manufacture at a lower cost, we are handicapped by the lack of a low freight rate, which renders us unable to compete with other concerns of certain localities. The economic location of the manufacturing plant should be governed by its source of supply, but in our case, at least, it is governed by railroads alone.

We have recently filled an order for 400,000 paving bricks for Bradentown, Fla., on which we could have made a material saving had we had an open river to the Gulf. At present Jacksonville, Fla., is in the market for 4,000,000 or 5,000,000 paving bricks. We will have to lose this order on account of the lower rate of the water haul from New York, from where they will be supplied. There is also at present a demand for 10,000,000 paving bricks in Cuba on which we are unable to compete because we have no water rates. We have recently been compelled to miss an order for about 1,000,000 paving bricks at Key West, on the same account. There are innumerable other contracts which we have had to forego, and you can therefore easily see what the opening of the Coosa River to the Gulf would mean to us and to the many other industries in our same condition.

The total output of our plant at present is 25,000 vitrified paving bricks per day, and 40,000 common commercial bricks. We are, however, making improvements that will increase this capacity in the near future to at least 30,000 paving and 50,000 common bricks. The aggregate tonnage of this output will be 150 tons per day, the greater part of which would go to the river were it opened to through navigation.

The benefit of an open river, as you can see, would be incalculable to us, and in consideration of this benefit, if the Government will give us this water route, I pledge myself and my company to construct and maintain, at or near Ragland, adequate wharf and wharf facilities to meet the demands of commerce, the same to be equipped with modern appliances as will best serve in loading, unloading, and transfer of freights, and to connect with the same by steam or electric railway.

I will further construct, or cause to be constructed, at least one boat and four 200-ton barges which will be operated by the company in marketing our products. This wharf will be constructed for the use of our company in addition to and irrespective of any other wharf that may be constructed by the city of Ragland, or other local industries. The above named wharf and vessels will be built and put into use as soon as the Government shall have progressed far enough with the improvement to make a through channel of sufficient depth available.

Very truly, yours,

C. H. Pittman,
Vice President and General Manager.

Mr. W. P. Lay,
Chairman Coosa River Improvement Association,
Gadsden, Ala.

Letter of Ragland Coal Co.

Ragland Coal Co.,
Ragland, Ala., October 30, 1909.

Dear Sir: In the matter of the improvement of the Coosa River, which the association is so ably striving to obtain, allow me to proffer my full support and hearty cooperation in the furtherance of this great work. In my opinion this is the most vital of the commercial interests of this State. In the opening of this waterway to through navigation to the Gulf is the one economic way of opening to the world our great store of agricultural and mineral wealth.

I am engaged in the development of the coal interests of this section, the deposits of which are almost inexhaustible. Our company is at present dependent upon one railroad for marketing off its product. Our total output will be about 2,000 tons per day, and it is no hard matter to reckon what the difference would be if we had advantages, like the Pittsburgh district, of a water course for its transportation. I have long been aware of the benefits to accrue from this source.

If the Government should decide to make this improvement, both the navigation and the water power thus developed would be of inestimable value to the State and to the whole South, and the Coosa Valley would unquestionably be one of the most attractive locations in the world for all kinds of manufacturing industries.

In this connection let me say that in consideration of the benefits to my company to be derived from this improvement, if the Government will open the river to through navigation to the Gulf, I hereby pledge myself and company to construct, or cause to be constructed, at our river landing at Ragland a modern wharf, equipped with the best approved appliances for loading, unloading, and transfer for freights, with steam or electric railroad connection. That I will construct, or cause to be constructed, and myself operate at least 1 towboat of the best design for the purpose, and 10 barges of 200-ton capacity. I pledge the good faith of myself and the company that this work shall be completed as soon as we shall have an adequate open channel over which to transport our freights to the Gulf.

In conclusion let me urge you and the association to do everything possible to gain material recognition from Congress.

Yours, very truly,

Ragland Coal Co.,
W. T. Brown,
President and General Manager.

Mr. W. P. Lay,
Chairman Coosa River Improvement Association, Gadsden, Ala.

LETTER OF ATLANTIC & GULF PORTLAND CEMENT CO.

ATLANTIC & GULF PORTLAND CEMENT CO.,
Nazareth, Pa., November 27, 1909.

DEAR SIR: Referring to the matter of the improvement of the Coosa River, which has been under discussion between us, allow me to express my interest and pledge my earnest support in this great work. I am a supporter of the policy to improve our inland waterways, and am eagerly enthusiastic over the project to make the Coosa River system one of the first of these to receive attention. In the first place, I am of the opinion—and I have given the matter careful study—that a through channel to the Gulf over the Coosa and Alabama Rivers will open to the world an enormous store of mineral and agricultural wealth, possible for any river or system of rivers in the United States. In the second place, such a water route concerns me vitally, for I expect to contribute largely to the tonnage that would make its commerce.

I am president of the Atlantic & Gulf Portland Cement Co., which is just completing a million-dollar plant for this purpose at Ragland, Ala. With the opening of the Panama Canal, if we had water transportation, our market would extend to the Pacific coast, to the Atlantic coast, and to all points in Central and South America. I feel sure that we would immediately find it necessary to double the output of the plant now under construction by building another of equal or of greater size.

The plant now nearing completion is situated on the river, and will manufacture annually 1,000,000 barrels of Portland cement, aggregating 200,000 tons, and valued at $1,000,000. If the Government will take up this work and give us a through channel for water transportation to the Gulf, I will guarantee to turn to the river at least 200,000 tons of freight per annum, either by putting it into the hands of some common carrier for transport, or by myself constructing, or causing to be constructed and operated, boats and barges sufficient to such needs. I will further, and I do hereby pledge myself and my company to construct, or cause to be constructed, a modern wharf at Ragland, Ala., equipped with the best approved appliances for the loading, unloading, transfer, and proper storage of freights, and to connect with the same by electric or steam railway.

The above agreement is made in good faith, and shall be considered binding, the pledge of myself and my company being hereby made to proceed with the fulfillment of the agreement as soon as the Government shall have so far progressed with the work of improvement that a through channel is available.

I heartily recommend the work of your association in this great enterprise, and sincerely hope that you may obtain material support from the present Congress.

Very truly, yours,

ATLANTIC & GULF PORTLAND CEMENT CO.
WM. B. SHAFFER, *President.*

Mr. W. P. LAY,
Chairman Coosa River Improvement Association, Gadsden, Ala.

LETTER OF MR. W. H. HASSINGER.

BIRMINGHAM, ALA., *November, 22, 1909.*

DEAR SIR: In reply to your letter of the 18th as to the probable commerce the Southern Iron & Steel Co. could, or would, throw to the Coosa River when it is opened to through navigation to the Gulf, I would state that this is, of course, more or less problematic. Our plant, when completed, will have an initial tonnage of 500 tons daily. As the plants become operative this will increase from time to time and in a short while will be doubled. As to what proportion of this product would go down by river it is quite impossible to say, but I will say that as a greater portion of this tonnage will go to the Southwest the initial route from Gadsden to Gulf ports would undoubtedly be so favorable as to warrant a large portion being shipped that way. By the time the Panama Canal is opened up our plants will have undoubtedly attained their maximum tonnage and will call for additional products, the demand for which will be practically unlimited. While we can not guarantee any definite tonnage it does look as if this would be the natural outlet for our products.

Trusting this gives you the desired information, and with kindest regards, I remain,

Very truly, yours,

W. H. HASSINGER, *President.*

Capt. W. P. LAY,
Chairman of the Coosa River Improvement Association, Gadsden, Ala.

LETTER OF ALABAMA MARBLE CO.

ALABAMA MARBLE CO.,
Gantts Quarry, Ala., October 27, 1909.

DEAR SIR: Referring to the matter of the Coosa River improvements, which has been the subject of correspondence between us, I desire to lay before you the following facts, in reference to the business of this company and the bearing the improvement of the river would have upon it.

At the present time, we are considerably handicapped by the existing freight rates in doing business with the eastern part of the United States, which is a very large market for marble. We have carefully investigated the question, and do not believe we can ever secure any material reduction, as long as we have an all-rail haul. If we had an all-water haul, there is no question whatever that the freight rate could be reduced to less than 50 per cent of what it is now. If that could be done, we would undertake to sell along the Atlantic coast of the United States at least 1,000,000 cubic feet of marble per year. In order to handle this business there would have to be, either in our possession or in the possession of some common carrier, a fleet of at least five 500-ton barges, which would be busy all the time either in carrying marble away from the quarry or bringing supplies to it. If no common carrier went into the business of operating such barges we would do it ourselves, because the business would justify it.

There is no question whatever, with the river open all the way from Gadsden to the Gulf, we could and would develop this business.

In addition to that we would be in a very favorable location with reference to the West Indies, to the east and west coasts of South America, to Mexico, and, after the completion of the Panama Canal, to our own Pacific coast.

There is no doubt whatever that we could develop at least as great a business with these localities as we could with the eastern part of our own country. This would simply double the amount of freight to be handled, taking a fleet of 10 500-ton barges, which would be busy all the time, with the marble business of this company alone.

With this company developing such a business there is no question whatever that many other marble companies would spring into existence, because in Talladega County there is an inexhaustible quantity of white marble of the same character as that which we are quarrying at Gantts Quarry. It is absolutely impossible for any one concern to monopolize this entire deposit. The other concerns would undoubtedly come into existence, and no doubt, in time, would develop just as good a business as we would.

We would be practically safe in promising that if the river were opened to navigation, as stated, that the exploitation of the marble deposits of Talladega County alone would be sufficient to furnish sufficient and adequate employment for the entire plant of a large transportation company.

Of course what the other resources of the country would furnish in the way of freight you can get from other sources better than you can from me, although from my own observations I think that the marble would be one of the small items. However, I am of the opinion that the marble business in Talladega County will ultimately develop, without the assistance of the river, to something like $10,000,000 per year.

With the assistance of an open river I have no doubt whatever it would soon reach a volume of $30,000,000 per year.

Under these circumstances I think it is the duty of every citizen of this part of the country to do all that he can to induce Congress to adopt the scheme for improving the river for both power and navigation. In reference to power I have said nothing, but if there were an adequate power development along the Coosa River we would undoubtedly buy all of our power instead of generating it ourselves; so would almost anybody else who started a manufacturing industry in this section.

As far as the marble deposit is concerned I have no doubt that it will ultimately furnish a market for probably 25,000 or 30,000 horsepower. While the total power available on the Coosa River is much larger than this, still it is quite an appreciable part of the whole.

Under all of the circumstances I think we are all thoroughly justified in appealing to Congress to put this project through just as soon as possible.

Very truly, yours,

JOHN STEPHEN SEWELL,
Vice President and General Manager Alabama Marble Co.

Mr. W. P. LAY,
Chairman Coosa River Improvement Association, Gadsden, Ala.

LETTER OF MASSACHUSETTS MILLS IN GEORGIA.

MASSACHUSETTS MILLS IN GEORGIA,
Lindale, Floyd County, Ga., November 24, 1909.

DEAR SIR: In regard to the opening of the Coosa River from Rome, I wish to say that I consider it a matter of the most vital importance for the textile industry in the South, especially in view of the fact that the Panama Canal will soon be open.

The majority of the cotton mills in the South are on export goods and now have to send their products transcontinental at a high rate of freight or ship to New York, whereas if the Coosa River opens we can concentrate our goods in Rome, ship direct to Mobile, and from there to the East; besides, the opening of the Coosa River would necessarily affect our freight rate here to New England and other points, as it would give us a water rate.

We ship in normal times 200 tons of cotton-factory products a week, a great bulk of which—in fact, three-quarters—is for the South American, India, and Chinese markets. With the proper facilities and the proper rate you can very readily see the advantage it would be to this mill to have the Coosa opened and ship that way.

Yours, truly,

H. P. MEIKLEHAM, *Agent.*

Mr. W. P. LAY,
President Coosa River Development Association, Gadsden, Ala.

ATMOSPHERIC NITROGEN.

The following list of atmospheric-nitrogen plants using the cyanamid process is issued by the Niagara Falls Co.:

Name.	Location.	Annual capacity.
		Tons.
Cyanid Gesellschaft	Trostberg, Germany	40,000
Deutsche Carbid, A. O	Knapsack, Germany	25,000
Gesellschaft für Stickstoffdunger	Westeregeln, Germany	10,000
Northwestern Cyanamide Co	Odde, Norway	30,000
Ostdeutsche Kalkstickstoffwerke und Chem. Fabriken.	Muhlthal, Germany	8,000
Societa Italiana del Carburo di Calcio	Collestate, Italy	15,000
Societa Suisse des Produits Azotes	Martigny, Switzerland	15,000
Societa Italiana per la Fabbr. di Prod. Azat	Piano d' Orta, Italy	25,000
Societe Française des Produits Azotes	Notre Dame de Briancon, France	15,000
Societa Piedmontese del Carburo di Calcio	St. Marcel, Italy	8,000
Company not yet named	Japan	30,000
American Cyanamid Co	Niagara Falls, Ontario	10,000
Total		231,000

One of the chief uses of atmospheric nitrogen is for fertilizer. The following data concerning the market for same was compiled by the Ashepoo Fertilizer Co., Charleston, S. C.:

Estimated consumption of manufactured fertilizers, based upon information furnished by the agricultural departments of the several States named.

States.	Estimated tonnage consumed.	
	1901–2	1907–8
Kentucky	45,000.00	40,000.00
Tennessee	(1)	46,384.00
Arkansas	(1)	(1)
Mississippi	77,857.90	137,831.95
Virginia	240,000.00	240,000.00
Florida	58,286.16	107,226.00
North Carolina	326,256.00	507,842.00
Louisiana	45,792.90	71,505.40
Alabama	184,295.00	312,470.00
South Carolina	302,335.00	565,885.00
Georgia	432,912.52	757,286.50
Total	1,712,735.48	2,786,430.85

[1] None given.

Estimated increase in 10 States, 1,073,695.37.

The following notes are from Daily Consular and Trade Reports, issued by the Department of Commerce and Labor, Bureau of Manufactures:

WATER POWER WANTED FOR AIR-NITRATE FACTORIES.

Representatives of European interests manufacturing air nitrates by hydroelectric power for fertilizers are in the United States to see what can be done in the way of securing large water powers for establishing such factories in this country. An industry of this kind is needed, as the imports of Chilean nitrate of soda now amount to $14,000,000 a year. Difficulty is being experienced, however, in securing suitable water powers at reasonable cost. Governments of other countries are said to be offering inducements for the location of the extensive nitrate mills which the company proposes to erect. (Report dated Mar. 12, 1909.)

TRANSVAAL POWER UTILIZATION—PROPOSED ERECTION OF A SECOND HYDROELECTRIC STATION.

Consul Edwin N. Gunsaulus, of Johannesburg, writes that in addition to the great scheme for supplying power to the Rand, a new company, to be known as the Pretoria Power Co., is being formed to supply power and to manufacture at a hydroelectric station on Crocodile River, nitrate of lime and nitric acid. Three large banks in Europe are said to be supplying the capital. For the initial works, which are to furnish 20,000 to 25,000 horsepower, $3,469,875 will be required, and for the nitrate of lime and nitric acid works $1,250,000 additional will be necessary. The present cost of nitrate of soda delivered to South African ports is about $54 per ton, while nitrate of lime, which serves the same purpose as a fertilizer, can be produced and sold, it is said, at half of that price in the Transvaal. There is considerable demand for nitric acid in South Africa for use in the manufacture of dynamite for mining purposes. (Report dated Aug. 25, 1909.)

AIR NITRATES IN GERMANY—TWO SYSTEMS ARE EMPLOYED IN THEIR MANUFACTURE.

Consul General A. M. Thackara, of Berlin, answers as follows the queries of an American correspondent regarding the manufacture of air nitrates and the status of farming in Germany:

"Atmospheric nitrogen is utilized in making nitrates for fertilizing purposes, in accordance with two general systems in Germany, as well as in Norway, Italy, and other European countries, and in Canada. (1) The formation of the so-called calcareous nitrogen (kalckstickstoff), which has the chemical formula Ca (CN) N, and which is formed by passing nitrogen over heated calcium carbide or through a heated mixture of lime and charcoal, and (2) the direct combination of the elements in the air—oxygen and nitrogen—by the use of the electric spark and the formation of nitrate by bringing these combinations into contact with the proper calcium or other components.

"There are several processes by means of which the nitrogen, which combines with the calcium carbide in the formation of calcareous nitrogen, is separated from the oxygen of the air. One is by passing air over the copper coils, by means of which the oxygen is removed. Another process is to obtain free nitrogen by the partial evaporation of liquefied air. The great expense attending this latter process renders it impracticable, and the nitrogen so obtained is still much mixed with oxygen compounds. Nitrogen is also obtained by one German firm in Hamburg and Hanover by cooling the gases of combustion and removing the impurities by passing the gases through retorts filled with copper and copper oxides, and then through some substance that absorbs the carbon dioxide.

Qualities of product—second system.—The so-called calcareous nitrogen obtained by the various processes is a grayish substance containing about 20 per cent nitrogen. As a fertilizer it is generally supposed to be as efficient as ammonium sulphate, and but little inferior to saltpeter. The exact effect of the cyanide in the compound is as yet not understood. By heating, the whole of the nitrogen in the compound is changed into ammonia, from which ammonium sulphate may be formed. The practicability of the production of calcareous nitrogen depends upon cheap power supply, and hence the plants are generally located where water power is available. The substance is produced in many different countries and the estimated total production for 1908 was about 45,000 tons.

The second system by which nitrates are obtained by the direct combination of the oxygen and nitrogen of the air is much more recent in its development than the above. After numerous attempts had been made in various countries, the Norwegian inventors, Birkeland and Eyde, finally succeeded in making the process industrially practicable (described in a monograph on "Manufacture of Air-Nitrates," recently published by the Bureau of Manufactures). According to their system, the end of each of the electric poles through which a current is passing is exposed to the action of a magnet which causes the electric spark to spread out into a disklike flame. This flame is surrounded by some material that resists combustion, thus leaving a disk-shaped inclosure through which the atmosphere is sucked. As the temperature at which this reaction takes place is very high and as the atmosphere passes comparatively rapidly through the flame, only from 1 to 2 per cent of the elements in the air is transformed. The compounds formed begin to decompose when their temperature is lowered, and therefore methods are devised to rapidly decrease their temperature to the point at which they can form more stable products. For this purpose the compounds are passed through an evaporation apparatus, and after their temperature has been reduced to about 50 degrees Réaumur they are passed into an oxidation chamber and oxidized into nitrogen dioxid, from which the nitrates are made. The farthest advance in this system has been made in Norway, principally by the firm of Birkeland & Eyde, and in factories located at Notodden, Svalgfos, and Christiansand. A similar system in Germany is used at the "Badische Anilin und Soda Fabrik" at Ludwigshafen and Rhein. The nitrates so formed are quite pure and have thus far been consumed principally in the industries, only a small quantity having been used as fertilizers.

Cost of production—works of reference.—The cost and the volume of production of each system depend upon the availability of cheap power, and the production of calcareous nitrogen also depends upon the prices at which lime and coal or charcoal are available. One estimate places the cost of the production of calcareous nitrogen containing 20 per cent nitrogen at 270 to 315 francs ($52.11 to $60.79) per metric ton (2,204.6 pounds). This would make the nitrogen in the compound cost 26 to 30 cents a kilo (2.2 pounds), while the cost of the nitrogen in compounds formed by the direct combination of the elements in the air is generally conceded to be less. The experiments made with fertilizers of either system, in comparison with Chilean saltpeter, are generally favorable to the artificial product. In sandy soil the calcium nitrate formed by the direct combination of the elements in the air brought even better results than the Chilean saltpeter.

A description and illustrations of the mechanical devices in use in the electrical system of producing atmospheric nitrogen is published by one Witt in Das neue Technisch-Chemische Institut for 1906, which may be procured for 2 marks ($0.476) at the Weidmanns'che Buchhandlung, Zimmer-Str. 94, Berlin, and a cursory description of the various processes in use in both systems, as well as the numbers of the various patents covering the same is given in Stahl und Eisen for May 19, 1909, published in Dusseldorf. Copies of the German patents may be procured at 1 to 2 marks each ($0.238 to $0.476) through an American or a German patent attorney.

Another book giving an exhaustive description of the technical and industrial application of atmospheric nitrogen is issued by Drs. Donath and Frenzel of the Technical High School at Brunn, and can be obtained from the book dealer A. Seydel, Koniggratzer-Str. 31, Berlin. The price of this book is 7 marks ($1.67)." (Report dated Dec. 13, 1909.)

Appendix L.

The Code of Alabama.

[Adopted by act of the Legislature of Alabama; approved July 27, 1907.]

Article 2, page 1477.—Easement and right to construct dams, 6148–6150.

6148. *Easement and right to construct dams across navigable rivers.*—Any person, firm, or corporation organized for the purpose of improving the navigation upon a navigable river in the State of Alabama, and of developing in connection therewith a water power thereof by a dam and lock, or a system of dams and locks, and electrically transmitting and distributing such power for the use of the public, which shall have acquired the necessary lands upon both sides of said river to the extent of at least one more than half of the necessary abutment sites for the said dam or system of dams, and lock or system of locks, and shall have been organized or incorporated for the specific and particular purpose of improving the navigation of and developing water power in connection with a particular and specified river, and has prepared plans for the construction of a dam or system of dams and a lock or system of locks appertaining thereto, and filed a copy of said plans in the office of the secretary of state of Alabama, together with a certified copy of its articles of incorporation (if a corporation), which provide both for the improvement of navigation of such river and for the development of the full water power of the same over the stretch of river thus to be improved, shall have authority to construct a dam or system of dams with a lock or system of locks appertaining thereto in such river, for the improvement of navigation of said river by one or more slack-water pools, due to the construction of said dam or dams and the development of water power in connection therewith, and to that end and in consideration of the benefits to the public by reason of the improvement of navigation of such river and the development of water power thereof, as herein provided, is hereby granted an easement for power purposes to and in the waters and bed of the river in which dam or system of dams and lock or system of locks are to be constructed for the full area covered by the slack-water pool or pools which will be created by the construction of the said dam or system of dams to the extent necessary for the developing the full power of said river over that length of same upon which navigation is to be improved as provided herein, and for providing suitable and convenient sites for the said dam or system of dams, lock, power houses, and other features appurtenant thereto and necessary for navigation and power purposes, or for either of them, and to the extent made necessary by the impounding, diversion, and conversion of the said waters as the same may be caused by the construction of said dam or system of dams, or by any other change from the normal state of the said river due to said construction and necessary for the purpose of deriving the energy therefrom.

6149. *Eminent domain, improvement of navigation.*—Any such person, firm, or corporation may exercise the power of eminent domain for the purpose of acquiring such lands as it may be necessary or convenient to flood or otherwise utilize in order to improve navigation as provided in this article, such lands to include, as well as all the area submerged, a strip of land 50 feet in width bordering upon the margins of the slack-water pool or pools as the same may be defined at the highest stage of the river at any time after the completion of the improvements herein provided for, and the right hereby conferred to exercise such power of eminent domain is cumulative. No person, firm, or corporation shall acquire the rights by this article granted unless the dam, or system of dams, and lock, or system of locks, to be constructed by such person, firm, or corporation are so planned as, when constructed, will by the operation thereof improve the navigation of the river in which the dam, or system of dams, lock, or system of locks, are to be built, and will develop the full power of such river over the length of same upon which navigation is to be improved as provided in this article: *Provided*, that such person, firm, or corporation shall commence work upon said dam, or system of dams, and lock, or system of locks, within five years from the date of securing the consent of the Federal Government to do so, and shall complete the same within the time prescribed by the United States Government: *Provided further*, That no foreign corporation shall acquire the rights granted under this article until it has complied with the laws of Alabama with reference to foreign corporations.

6150. *Prior rights.*—The person, firm, or corporation which first in point of time shall have complied with provisions of this article shall be entitled to all the rights and privileges herein granted, and the operation of this section shall be retroactive.

Memorandum No. 1.

Cost of Steam Power.

[From Water Power Engineering, by Mead.]

Table LV shows the capital costs of steam-power plants of various capacities and the annual cost of power per brake horsepower as estimated by the Ontario Hydro-Electric Power Commission. Similar costs for producer gas power are shown in Table LVI from the same source, and the commission's estimate of the effect on the cost of power of variations in the price of coal is shown in Table LVII.

TABLE LV.—*Showing capital costs of steam plants installed and annual costs of power per brake horsepower.*

Size of plant (horsepower).	Capital cost of plant per horsepower installed.			Annual cost of 10-hour power per brake horsepower.	Annual cost of 24-hour power per brake horsepower.
	Engines, boilers, etc., installed.	Buildings.	Total.		
CLASS I.—*Engines: Simple, slide-valve, noncondensing. Boilers: Return tubular.*					
10	$66.00	$40.00	$106.00	$91.16	$180.76
20	56.00	37.00	93.00	76.31	151.48
30	48.70	35.00	83.70	66.46	131.68
40	44.75	33.50	78.25	59.46	117.74
50	43.00	31.00	74.00	53.95	106.46
CLASS II.—*Engines: Simple, Corliss, noncondensing. Boilers: Return tubular.*					
30	70.70	35.00	105.70	61.14	117.70
40	62.85	33.50	96.35	55.50	107.10
50	59.00	31.00	90.00	50.70	97.73
60	56.00	30.00	86.70	47.42	91.34
80	50.00	27.50	77.50	43.86	85.41
100	44.60	25.00	69.60	40.55	79.19
CLASS III.—*Engines: Compound, Corliss, condensing. Boilers: Return tubular, with reserve capacity.*					
100	63.40	28.00	91.40	33.18	60.05
150	53.70	24.00	77.70	29.83	54.63
200	50.10	20.00	70.10	28.14	51.72
300	45.90	18.00	63.90	26.27	48.83
400	43.55	16.00	59.55	24.84	46.12
500	41.25	14.00	55.25	23.73	44.21
750	40.50	13.00	53.50	23.56	44.02
1,000	39.00	12.00	51.00	23.26	43.71
CLASS IV.—*Engines: Compound, Corliss, condensing. Boilers: Water-tube, with reserve capacity.*					
300	55.20	18.00	73.20	25.77	46.32
400	51.50	16.00	67.50	24.18	43.61
500	49.40	14.00	63.40	23.19	42.03
750	46.80	13.00	59.70	22.88	41.56
1,000	44.30	12.00	56.80	22.47	41.11

NOTE.—Annual costs include interest at 5 per cent, depreciation and repairs on plant, oil and waste, labor and fuel (coal at $4 per ton).
Brake horsepower is the mechanical power at engine shaft.

TABLE LVI.—*Showing capital costs of producer gas plants installed and annual costs of power per brake horsepower.*

Size of plant (horsepower).	Capital cost of plant per horsepower installed.			Annual cost of 10-hour power per brake horsepower.	Annual cost of 24-hour power per brake horsepower.
	Machinery, etc.	Buildings.	Total.		
10	$137.00	$40.00	$177.00	$53.48	$90.02
20	110.00	36.00	146.00	44.47	75.22
30	93.00	33.00	126.00	38.73	65.99
40	84.50	29.00	113.50	85.05	59.85
50	80.00	26.00	106.00	32.27	55.22
60	79.00	24.00	103.00	30.49	52.03
80	78.20	22.00	100.20	28.70	48.95
100	77.50	20.00	97.50	27.05	45.40
150	76.00	19.00	95.00	25.87	43.17
200	74.00	17.00	91.00	24.95	41.78
300	73.00	16.00	89.00	24.24	40.40
400	71.50	14.00	85.50	23.41	39.03
500	70.00	12.00	82.00	22.54	37.54
750	67.50	10.00	77.50	21.55	35.99
1,000	65.00	8.00	73.00	20.46	34.66

NOTE.—Annual costs include interest at 5 per cent, depreciation and repairs on plant, oil and waste, labor and fuel (bituminous coal at $4 and anthracite coal at $5 per ton).

TABLE LVII.—*Showing the effect on the cost of power of a variation in the price of coal of 50 cents per ton.*

Size of plant (horsepower).	Suction producer gas.		Steam.		
	10-hour.	24-hour.	Kind of engine.	10-hour.	24-hour.
10	$1.15	$2.53	Simple slide valve	$6.14	$13.47
20	1.13	2.46		5.25	11.56
30	1.10	2.40		4.71	10.35
40	1.07	2.33	Simple automatic noncondensing.	3.56	7.84
50	1.04	2.29		3.37	7.41
60	1.01	2.24		3.26	7.16
80	.98	2.18		3.15	6.97
100	.96	2.12		3.12	6.87
150	.94	2.07	Compound condensing	1.75	3.85
200	.92	2.02		1.69	3.71
300	.90	1.98		1.62	3.60
400	.88	1.94		1.56	3.44
500	.86	1.89	Compound condensing water-tube boilers.	1.39	3.05
750	.82	1.81		1.39	3.05
1,000	.76	1.72		1.39	3.05

Mr. H. A. Foster [1] made actual tests of 22 different power plants, including manufacturing establishments, electric-light stations, pumping plants, etc., and determined for each plant the power consumption per annum and its cost, including not only running expenses, but fixed charges. The cost per horsepower per annum varied from a minimum of $15.69 to a maximum of $233.95.

TABLE LVIII.—*Showing average power developed and its cost per horsepower in 22 steam-power plants.*

Output.		Operating expenses per horsepower.	Fixed charges per horsepower.	Total cost per horsepower per annum.	Cost per horsepower-hour.
Average horsepower developed.	Number of days per annum.				
					Cents.
12.4	361	$147.93	$25.40	$173.33	5.648
20.9	365	123.12	28.42	151.54	1.868
21.5	361	90.47	17.80	108.27	2.918
32.9	330	22.56	5.83	28.39	.832
36.7	365	137.25	96.70	233.95	2.811
42.4	365	86.38	63.20	149.58	1.708
53.0	309	56.94	19.51	76.45	1.596
58.8	365	97.30	33.82	131.12	1.613
70.4	365	101.69	20.78	122.45	1.641
129.3	365	30.14	9.41	39.55	.871
166.7	313	15.19	4.47	19.66	.639
173.0	313	22.66	5.83	28.39	3.333
210.9	290	40.33	7.86	48.19	.693
296.7	297	45.56	7.81	53.37	.749
926.0	307	11.73	8.77	20.50	.691
1,010.8	306	15.70	7.74	23.44	.794
1,174.8	306	10.19	5.50	15.69	.531
1,278.7	293	10.49	6.23	16.72	.590
1,345.5	365	23.28	9.42	32.70	.820
1,352.0	365	33.03	29.41	62.44	.713
1,909.7	306	13.40	6.63	20.03	.677
2,422.0	306	15.67	6.73	22.40	.757

COST OF STEAM POWER.

[By William O. Webber, in the Engineering Magazine, July, 1908.]

The cost of water-power rights must be considered, also available space and cost thereof for steam plants. The cost of one steam horsepower per brake horsepower per year, with simple engines and $2 coal, he makes $62.10.

[1] See Trans. Am. Inst. E. E., Vol. 14, p. 385.

Actual cost of 1 horsepower per year in several plants.

Average horse-power.	Cost of coal per ton (2,240 pounds).	Total cost per annum.	Remarks.
182	$3.50	$57.59	No land or building cost.
133	3.25	60.00	No land cost.
100	3.50	65.60	No land or building cost.
97	4.45	86.80	All costs included.
75	2.90	92.40	No land or building cost.
50	4.75	111.05	Do.
20	4.45	133.50	All costs included.

Cost of 1 steam horsepower per brake horsepower per year (compound condensing engines).

	Size of plant in horsepower.						
	100	200	300	400	500	1,000	1,500
Cost of plant per horsepower	$170.00	$146.00	$126.00	$110.00	$96.00	$60.00	$58.00
Fixed charges at 14 per cent	23.80	20.40	17.65	15.40	13.45	8.40	8.12
Coal per horsepower per hour	7.00	6.50	6.00	5.50	5.00	2.50	2.00
Cost of fuel at $4 per ton	38.50	35.70	33.00	32.00	27.50	13.75	11.00
Attendance, 10-hour basis	12.00	10.00	8.60	7.25	6.20	3.50	3.25
Oil, waste, and supplies	2.40	2.00	1.72	1.45	1.24	.70	.65
Total	76.70	68.10	60.97	56.10	48.39	26.35	23.02
Coal, at $5 per ton	86.40	77.10	69.22	61.90	55.29	29.80	25.77
Coal, at $4.50 per ton	81.50	72.60	65.07	58.10	51.79	28.05	24.39
Coal, at $4 per ton	76.70	68.10	60.97	56.10	48.39	26.35	23.02
Coal, at $3.50 per ton	71.90	63.70	56.82	50.50	45.04	24.60	21.64
Coal, at $3 per ton	67.00	59.20	51.67	46.70	41.49	22.90	20.27
Coal, at $2.50 per ton	62.30	54.75	48.59	43.00	38.09	21.20	18.89
Coal, at $2 per ton	57.45	50.25	44.47	40.10	34.64	19.47	17.52

Cost of 1 steam horsepower per brake horsepower per annum, 308 days (triple condensing engines).

Size of plant.........in horsepower	3,000		4,000		5,000		6,000	
Cost of plant per horsepower	$54		$52		$50		$48	
Coal per horsepower hour...pounds	1.375		1.25		1.125		1	
Fixed charges, at 14 per cent	$7.56		$7.28		$7		$6.72	
	10 hours.	24 hours.	10 hours.	24 hours.	10 hours.	24 hours.	10 hours.	24 hours.
Fuel, at $4 per ton	$7.46	$14.92	$6.87	$13.75	$6.18	$12.37	$5.50	$11.00
Attendance, 10-hour basis	2.75	5.50	2.50	5.00	2.25	4.50	2.00	4.00
Oil, waste, and supplies	.50	1.20	.40	.96	.35	.84	.30	.72
Total, coal at $4	18.27	29.18	17.06	26.99	15.79	24.72	14.52	22.44
Total, coal at $3	16.40	25.45	15.40	23.56	14.24	21.90	13.14	19.69
Total, coal at $2.50	15.47	23.59	14.38	21.84	13.47	20.22	12.46	18.32
Total, coal at $2	14.54	21.72	13.76	20.12	12.69	18.53	11.77	16.94

Cost of Steam Power.

[By Howard S. Knowlton, in the Engineering Magazine, Februay, 1909.]

Table 3.—*Cost in cents per kilowatt-hour manufactured.*

	Boston.	Worcester.	Lowell.	Fall River.	Malden.	Cambridge.	Lynn.
Fuel	0.462	0.703	0.710	0.880	0.635	0.690	0.618
Oil and waste	.008	.027	.009	.032	.017	.019	.012
Water	.024	.034	.008	.012	.032	.055	.040
Wages	.192	.360	.262	.538	.342	.347	.296
Station repairs	.015	.012	.020	.012	.035	.021	.052
Steam repairs	.042	.055	.020	.037	.072	.059	.147
Electrical repairs	.056	.055	.009	.029	.014	.046	.045
Miscellaneous	.023	....	.022	.080	.033	....	....
Total	.822	1.246	1.060	1.620	1.180	1.237	1.210

The equipment of each plant is of modern type, thoroughly representative of good practice in the design of steam-generating stations using either reciprocating engines or turbines, and operating condensing. The figures presented are for the year ending June 30, 1908.

Memorandum No. 2.

Cost of Hydroelectric Power.

[From Water Power Engineering, by Mead.]

Table XLII.—*Estimate of the cost of a hydroelectric plant at Niagara Falls.*[1]

Items.	24-hour power capacity.		
	50,000 horse-power develop-ment.	75,000 horse-power develop-ment.	100,000 horse-power develop-ment.
Tunnel tail race	$1,250,000	$1,250,000	$1,250,000
Headworks and canal	450,000	450,000	450,000
Wheel pit	500,000	700,000	700,000
Power house	300,000	450,000	600,000
Hydraulic equipment	1,080,000	1,440,000	1,980,000
Electric equipment	760,000	910,000	1,400,000
Transformer station and equipment	350,000	525,000	700,000
Office building and machine shop	100,000	100,000	100,000
Miscellaneous	75,000	75,000	75,000
	4,865,000	5,900,000	7,255,000
Engineering and contingencies, 10 per cent	485,000	590,000	725,000
	5,350,000	6,490,000	7,980,000
Interest, 2 years, at 4 per cent	436,560	529,584	651,168
Total capital cost	5,786,560	7,019,584	8,631,168
Per horsepower	114	94	86

[1] First Report of Hydro-Electric Power Commission of the Province of Ontario, p. 15.

Other things being comparatively equal, the cost of development varies inversely, although not in the same ratio, as the head. The reason of this is evident from the fact that while the power of a stream is directly proportional to the head, the capacity of a turbine increases as the three-halves power of the head. With double the head the power of a wheel is increased almost three times.

For moderate changes in head, the cost of the turbines will vary in proportion to their size and not their capacity, so that the cost per unit of capacity will usually decrease considerably with the head. The cost per unit of capacity of other features of water-power plants will also frequently decrease as the head increases. This is particularly true of pondage capacity, which increases in value directly as the head increases, although the cost per unit of land overflowed may remain constant. The relative cost of high and low head developments may be illustrated by the comparative cost of two plants recently designed by the writer which were of approximately the same capacity but working under different heads. The comparison is as follows:

Table XLIII.—*Comparative cost of water-power plants.*

Capacity.	Head.	Cost of water-power development.			
		Without dam.	With dam.	With dam and electrical equipment.	With dam, electrical equipment, and trans-mission line.
8,000 horsepower	18	63.50	86	115	150
Do	80	21.00	39	60	90

TABLE XLIV.—*Estimates of the cost of developing various Comachian power from reports of Ontario Hydroelectric Power Commission.*

Location of proposed development.	Natural head.	Available head.	Power developed, horsepower.	Estimated capital cost.	Cost per horsepower.
I.					
Healeys Falls, Lower Trent River	....	60	8,000	$675,000	$84.38
Middle Falls, Lower Trent River	....	30	5,200	475,000	91.37
Rauneys Fall	....	35	6,000	425,000	69.67
Rapids above Glen Miller	....	18	3,200	350,000	109.38
Rapids above Trenton	....	18	3,200	370,000	115.63
II.					
Maitland River	....	[1] 80	1,600	325,000	203.12
Saugeen River	....	40	1,333	250,000	187.53
Beaver River (Eugenia Falls)	....	420	2,267	291,000	128.28
Severn River (Big Chute)	....	[2] 52	4,000	350,000	87.50
South River	....	85	750	115,000	153.33
III.					
St. Lawrence River, Iroquois, Ontario	....	12	1,200	179,000	149.16
Mississippi River, High Falls, Ontario:					
(a)	....	[3] 78	2,400	195,000	81.25
(b)	....	78	1,100	123,000	181.82
Montreal River, Fountain Falls, Ontario	....	27	2,400	214,000	89.16
IV.					
Dog Lake, Kaministiquia River	347	[4] 310	13,676	832,000	61.00
	347	310	6,840	619,700	91.00
Cameron Rapids	39	....	16,350	815,000	50.00
	39	....	8,250	600,000	73.00
Slate Falls	31	40	3,686	357,600	97.00
	31	40	1,843	260,000	141.00

[1] Third report; dam rather expensive.
[2] Head works and canal less expensive than ordinary.
[3] With storage developed.
[4] Including 3,500 feet of headwater tunnel.

TABLE XLV.—*Development costs of various American water-power plants.*

Name or location of plant.	Reference.	Head, in feet.	Horsepower capacity at turbine shaft.	Cost.	Cost per horsepower.	Notes.
1. Chicago Drainage Canal, Lockport, Ill.	Electrical World, 1906, vol. 47, p. 398.	28	15,500	$3,500,000	$225.80	Note D.
2. Columbus, Ga	Electrical World and Engineer, 1904, vol. 43, p. 165.	40	9,000	450,000	50.00	Notes C and E.
3. Catawba, S. C	Engineering Record, 1904, vol. 50, pp. 114, 129.	25	10,000	1,100,000	110.00	Notes D and F.
4. Tariffville, Conn	American Electrician, 1900, vol. 12, p. 107.	31	2,300	....	125.00	Note D.
5. Delta, Pa	Engineering News, 1898, vol. 39, p. 250.	42	550	30,000	54.00	Notes D and G.
6. Lachine, Montreal	Electrical World, 1898, vol. 31, p. 744.	16	6,600	957,200	145.80	Notes D and H.
7. Winnipeg, Manitoba.	Electrical World, 1906, vol. 47, p. 1291.	40	25,600	4,000,000	156.25	Notes D and I.
8. Manchester, N. H		30	6,000	....	66.00	Notes A and J.
9. Lowell, Mass		13	....	....	110.00	Notes A and J.
10. Lowell, Mass	The Engineer, 1902, vol. 39, p. 64.	18	....	....	57.00	Notes A and J.
11. Big Cottonwood, Utah.		370	3,000	325,000	108.25	Notes D and K.
12. Lawrence, Mass		....	1,000	....	67.50	Notes A and J.
13. Spier Falls, N. Y	Scientific American, Sept. 12, 1903.	90	50,000	2,100,000	42.00	Note C.

Table XLVI.—*Development costs of various foreign water-power plants.*

Name or location of plant.	Reference.	Head, in feet.	Horsepower capacity at turbine shaft.	Cost.	Cost per horsepower.	Notes.
Zurich, Switzerland	Electricity (N. Y.), 1899, vol. 16, p. 148.	(1)	25,300	$4,650,000	$183.90	Notes D and L.
Rhinefelden, Germany.	Electrician (London), 1897, vol. 38, p. 716.	10–16	15,000	1,225,000	81.70	Note C.
Paderno, Italy	The Engineer, 1902, vol. 39, p. 64.	90	13,000	....	120.00	Note B.
Champ, France	Engineering Record, 1905, vol. 52, p. 648.	104	6,750	1,000,000	148.00	Note D.
Department de l'Isere, France.	Electrical Review (London), 1898, vol. 43, p. 475.	330	4,000	136,000	34.00	Note B.
Department de Jura, France.		6.5	300	45,000	150.00	Note D.
Upper Savoy, France		450	11,000	182,000	165.50	Notes C and M.
Chedde, France	Die Ausnutzung der Wasserkrafts, p. 198. F. Mattern.	455	10,000	....	30.00 42.50	Note A. Notes C and N.
Chevres, Switzerland		14–27	9,600	1,044,000	109.00	Note B.
Kubel, Switzerland		296	5,000	1,074,000	215.00	Notes D and O.
Schaffhausen, Germany.		(2)	2,700	365,000	135.00	Notes D and P.
Gersthofen, Germany		(3)	6,000	812,500	135.00	Note B.
Augsburg, Germany		....	9,100	1,875,000	206.00	Note D.
Heimbach, Germany		230–360	16,500	2,125,000	130.00	Notes D and Q.
Lyon, France		33–40	22,750	6,500,000	287.50	Notes D and R.
Muhlhausen, Germany.		24–30	23,000	3,075,000	132.50	Note B.

[1] Very low. [2] 13.8 to 15.8; 11.5 to 14.8. [3] 32.8 to 34.4.

Notes in Tables XLV and XLVI.

Note A.—The cost of water-power development, not including dam.
Note B.—The cost of water-power development, including dam.
Note C.—The cost of complete water-power development, including electric station equipment.
Note D.—The cost of complete water-power development, including electric station equipment and transmission lines.
Note E.—Mostly 12-hour horsepower distributed to adjacent mills at the generated voltage.
Note F.—Severe climatic and river conditions during construction.
Note G.—Very favorable location; cheap timber dam; transmission line only 5 miles long.
Note H.—Includes extra real estate investment.
Note I.—Expensive canals in rock and very extensive concrete construction.
Note J.—Factory installation.
Note K.—Pelton wheels and 1,500 feet wood-stave pipe line.
Note L.—Four interconnected plants; including also steam auxiliary.
Note M.—Not including 5,000 horsepower necessary steam auxiliary.
Note N.—Not including dam.
Note O.—With 1,000 horsepower steam auxiliary.
Note P.—Two interconnected plants.
Note Q.—15-mile transmission line.
Note R.—12-mile feeder canal.

Hydroelectric Practice.

[By Von Schon.]

Article 27. The power equipment consists of water turbines, with governors and draft tubes, and of electric generators, exciters, and switchboards. When generators are coupled to turbine shafts and the units are of standard type, an estimate of $20 per horsepower will generally cover its cost; when turbines have to be geared to generator shafts, the cost per horsepower will be $24.

Art. 28. The last item comprises the transmission line and equipment. As a rule, a wooden-pole line is recommendable, poles being 35 feet long and set 106 feet apart. A single circuit will be sufficient excepting for large outputs. Such a line requires cross arms, pins, insulators, and three strands of bare copper wire the size, and therefore weight, of which depends upon the amount of current to be transmitted, the voltage of transmission, and the drop or loss to be allowed. On lines up to 50 miles the loss may be economically confined to 10 per cent.

Diagram 16 gives quantity of copper wire for transmission line, for different output and voltage, at 5 per cent line drop per mile, to which are to be added 50 poles, 100 cross arms, 150 pins and insulators for single-circuit three-phase line.

Transformers to raise and lower voltage at terminals of line cost $6 per kilowatt of output.

A substation has to be provided at market end of line, which may be estimated for at $1 per horsepower.

NOTE.—Of course, the cost of turbines will vary with the head, according to the rule laid down by Mead. The general rule of article 27 above will apply to a head of about 60 feet. (H. B. F.)

STEAM.

[From Electric Power Transmission, by Bell.]

DIGEST OF CHAPTER XVI.

Dr. C. E. Emery gives the following table for 500 net horsepower of 10 hours for 308 days in the year:

Kind of engine.	Coal $2 per ton.	Coal $3 per ton.	Coal $4 per ton.	Coal $5 per ton.
Simple high speed	$29.81	$36.17	$42.54	$48.90
Simple low speed	28.46	34.20	39.94	45.67
Simple low speed, condensing	22.82	26.77	30.73	34.69
Compound condensing, low speed	21.97	25.53	29.09	32.65
Triple expansion condensing, low speed	22.35	25.32	28.28	31.25

Bell says that, assuming a power of 1,000 brake horsepower and coal at $2 per long ton, and making the necessary modifications in the data as just indicated (that is, reducing labor cost and reducing interest to 5 per cent), the cost of the horsepower year on the basis of 308 days of 10 hours each per year, with first-class compound condensing engines, falls to about $17 to $18. These figures have unquestionably been reached in actual practice, although rather seldom. They must, however, now and then be reckoned with, and can be met only by very carefully planned transmission from an unusually cheap water power. As a rule, even in large engine plants, the cost per horsepower year of 3,080 hours runs above rather than below $20. On variable load the costs are likely to run 20 or 25 per cent higher. There are few cases in which transmission from cheap waterpower on a large scale can not beat out steam power even in large units.

In units under 50 horsepower one is very unlikely to find the horsepower year, reckoned on the above basis of 10 hours per day, costing less than $50, even with coal as low as $2 per long ton.

Dr. Emery has worked out at considerable length the problem of the cost of steam power on a very large scale and with the most economical modern machinery. He assumed a 20,000 horsepower plant, worked 24 hours per day, on a variable load averaging 12,760 horsepower, 63.8 per cent of the maximum. This load factor is judiciously estimated and could certainly be realized in a plant of such size, employed in the general distribution of power. Taking coal at one mill per pound, $2.24 per long ton, and entering every item of expense, he found the total cost per horsepower per year to be $33.14. If the plant were established at the mouth of the coal mine, fuel should be obtained at not over one-third the above cost. This advantage would bring the cost per horsepower per year down to $24.89. Taking now 15,000 kilowatt in dynamo capacity in large direct coupled units, say five in number, the electrical plant would cost, installed with all needful accessories and ready to run, $200,000. Taking interest, taxes, and depreciation together at 10 per cent, which is enough, since a 3 per cent sinking fund would amply allow for depreciation; allowing $15,000 per year for additional labor and superintendence and $10,000 more for maintenance and miscellaneous expenses, brings the total annual charge for the electrical machinery to $45,000. Adding this to the steam power item and reducing the whole to cost per kilowatt-hour, assuming 94 per cent average dynamo efficiency, the total cost per kilowatt-hour delivered at the station switchboard becomes 0.436 cent. Working, then, on an immense scale from cheap coal, it is safe to say that less than half a cent per kilowatt-hour will deliver the energy to the bus bars.

The next step is the cost of delivering it to the customer. This varies so greatly, according to circumstances, that an average is very hard to strike. A plant such as we are considering will usually be installed only when the radius of distribution is fairly long. Taking the transmission power as 50 miles, the line and right of way, using 30,000 volts, may be taken as about $25 per kilowatt; the raising and reducing transformers with substation and equipment would cost perhaps $15 per kilowatt and the distributing circuits, with a fair proportion of large motors, about $10 per kilowatt additional. The complete distributing system for 15,000 kilowatt would then cost about $750,000. Figuring interest and depreciation roundly at 10 per cent, the annual charge is $75,000. Add now $15,000 for labor in substation and distributing system, $10,000 for general administrative expense, and 5 per cent on the cost for maintenance and miscellaneous expenses, and we reach a total annual charge for distribution of $137,500. The average output being almost exactly 9,000 kilowatts, the cost of distribution per kilowatt hour is 0.174 cent. The actual cost of generating and distributing the power then becomes 0.610 cent per kilowatt-hour. This is probably pretty nearly a minimum for distribution of power from coal mines.

Page 333.—The best triple-expansion condensing engines worked under favorable conditions can be counted on to do a little better than 1.5 pounds of coal per indicated horsepower hour, occasionally even in the neighborhood of 1.25 pounds. Even with compound condensing engines, tests are now and then recorded, showing below 1.5 pounds of coal per indicated horsepower-hour.

Memorandum No. 3.

Cost and dimensions of some storage reservoirs.

UNITED STATES.

Name.	Locality.	Character.	Capacity.	Maximum height of dam.	Cost per acre-foot, stored.
			Acre-feet.	*Feet.*	
Pathfinder	Wyoming	Masonry	1,025,000	215	$0.48
Tyler	Texas	Hydraulic fill	1,770		.64
Indian River	New York	Masonry	102,550	47	.80
Buena Vista Lake	California	Earth	170,000		.88
Laramie River	Wyoming	do	120,000		.98
Shoshone	do	Masonry	456,000	325	1.20
Roosevelt	Arizona	do	1,284,000	280	1.46
Upper Deer Flat	Idaho	Earth	186,000	68	2.05
Lake McMillan	New Mexico	Loose rock and earth	89,000	52	2.23
Eureka Lake	California	Rock fill	15,170		2.32
Windsor	Colorado	Earth	23,000		3.26
Bell Fourche	South Dakota	do	207,770	115	5.00
Bear Valley	California	Masonry	40,550	64	5.30
Faucherie	do	Rock fill	1,350		5.92
East Canyon Creek	Utah	Loose rock, steel core	5,700	68	7.00
Cuyamaca	California	Earth	11,500	40	9.00
English	do	Rock-fill crib	14,900		10.40
Bowman	do	Loose rock, timber	20,600	100	11.18
Sweetwater	do	Masonry	22,570	95	11.72
Wachusett	Massachusetts	do	193,300		11.74
Glenwild	New York	Earth	3,675		12.90
La Mesa	California	Hydraulic fill	1,300		13.10
Hemet Valley	do	Masonry	10,500	122	14.29
Cache la Poudre	Colorado	Earth	5,650	38	19.50
Sodom	New York	Masonry and earth	14,980		24.50
Merced	California	Earth	15,000	54	26.60
Lake Avalon	New Mexico	Rock fill and earth	6,300		27.94
Escondido	California	Rock fill	3,500		31.44
Saguache	Colorado	Earth	954		31.45
Apishapa	do	do	459		32.18
Yorba	California	Hydraulic fill	1,171		32.50
Castlewood	Colorado	Loose rock, masonry	12,300	70	38.00
Monument	do	Earth	885		38.69
San Leandro	California	do	13,270	155	40.00
Bog Brook	New York	do	12,720		40.12
New Croton	do	Masonry	180,000		42.00
Do	do	do	98,200	290	42.30
Titicus	do	Masonry and earth	22,000		42.42
Canistear	New Jersey	Earth	7,390		46.15
Round Hill	Pennsylvania	Masonry and earth	4,050		59.39
Boss Lake	Colorado	Earth	205		71.39
Pedlar River	Virginia	Concrete	1,115		93.00
Hardscrabble	Colorado	Earth	102		97.78
Walnut Canyon	Arizona	Masonry	480		114.60
Wigwam	Connecticut	do	1,028		145.90
Williams	Arizona	do	338		156.35
Seligman	do	do	703		169.50
Cedar Grove	New Jersey	Earth	2,150		307.00
Ash Fork	Arizona	Steel	110		416.30

Cost and dimensions of some storage reservoirs—Continued.

FOREIGN.

Name.	Locality.	Character.	Capacity.	Maximum height of dam.	Cost per acre-foot, stored.
			Acre-feet.	*Feet.*	
Bhatgur	India	Masonry	126,500	127	$3.20
Ekruk	do	Earth	76,100	72	4.00
Perair	do	Masonry	157,000	155	4.65
Ashti	do	Earth	32,600	58	4.80
Chumbrumbaukum	do	do	63,780		4.89
Lake Fife	do	Masonry	75,500		8.34
Betwa	do	do	54,300	61.5	9.10
Assoun	Egypt	do	863,000		13.80
Tansa	India	do	52,670		18.76
Belubula	Australia	Brick and concrete	2,000		22.50
Lake Oredon	France	Earth	5,894		24.00
Villar	Spain	Masonry	15,500	170	25.20
Beetaloo	Australia	do	18,400	110	31.84
Liez	France	Earth	13,051		46.00
Patas	India	do	325		49.00
Vyrnwy	Wales	Masonry	44,690		74.71
Wassy	France	Earth	1,740		80.00
Terney	do	Masonry	2,433		84.00
Gilleppe	Belgium	do	9,730		89.83
Remscheid	Germany	do	811		112.45
Chartrain	France	do	3,647		115.10
Talla Reservoir dam	Edinburgh	Earth	10,280		118.66
Ban	France	Masonry	1,499		127.00
Mouche	do	do	7,011		143.00
Burraga	Australia	do	310		150.00
Cousin	France	do	1,297		190.00
San River	South Africa	Concrete	660		212.10
Pas du Riot	France	Masonry	1,054		243.00
Furens	do	do	1,297		245.00
Burrater	England	Masonry and earth	2,410		250.00
Lauchensee	Germany	Masonry	624		390.00

NOTE.—Above taken from Irrigation Engineering, by Wilson; and Reservoirs for Irrigation, Water Power, and Domestic Water Supply, by Schuyler.

SUPPLEMENTAL REPORT ON LOCAL COOPERATION.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Montgomery, Ala., July 13, 1912.

SIR: 1. * * * I have the honor to submit herewith the supplemental report ordered on the subject of local cooperation in the improvement of Etowah, Coosa, and Tallapoosa Rivers.

2. On April 20, 1912, a circular letter, copy inclosed, was sent to all parties known or supposed to be interested. This circular letter, which invited those interested to present any propositions they might desire, also gave notice of a meeting to be held at this office on May 20, 1912, for a complete discussion of the matter. This meeting was further given prominence as a news item by the local press.

3. But two people appeared for a short time at this office on the day appointed—Mr. W. P. Lay, of Gadsden, Ala., who submitted a letter, and Mr. R. H. Elliott, who stated that he represented certain interests in Birmingham, Ala., controlling the land on one side at one of the proposed dam sites (No. 7), and promised to submit later a letter, which, however, he failed to do. These gentlemen were fully informed as to the object of the meeting, but there was no discussion. In addition, a letter was received from Mr. James Mitchell, who did

not appear personally. Mr. Lay and Mr. Mitchell both represent the interests of the Alabama Interstate Power Co. The original letters of Mr. Lay and Mr. Mitchell, together with a copy of each, are forwarded herewith.

4. As will be seen from these letters, no plan of local cooperation was submitted.

5. While the Alabama Interstate Power Co., a company backed by large amounts of English and Canadian capital, is not yet ready to propose any plan of cooperation, it is, nevertheless, gradually acquiring all available sites on the Coosa and Tallapoosa Rivers and is making careful surveys of both rivers. I was informed a few days ago that this company now controls every dam site on the Tallapoosa River and every one, excepting one side of No. 7, on the Coosa River. It is understood that the plans of this company are to develop water power on the Coosa River first, beginning with No. 12, and thereafter to develop water power on the Tallapoosa.

6. Whether or not it is advisable as a question of public policy for the Government to permit one company to acquire a monopoly of all the valuable water power on the Coosa and Tallapoosa Rivers is apparently a question for higher authority.

7. The ultimate development of these streams along the lines of Capt. Ferguson's recommendations, as set forth in his report to the Chief of Engineers, dated June 10, 1910, appears worthy of being undertaken by the General Government. If this be done, however, it should not be postponed, as the value of land and costs of labor and material in the South are advancing steadily; and for every year this improvement, if undertaken, is delayed an increase in the estimated cost of the project must be expected.

8. It is recommended that in case this improvement be undertaken the Government expenditure be not that recommended by Capt. Ferguson, namely:

For navigation only	$6,990,000
For navigation share of 6 high dams on Coosa	4,013,000
For Etowah Reservoir	4,000,000
	15,003,000

But that the United States provide not merely for navigation, but if permissible under the law build the substructures of the power houses in the six high dams, at an estimated total cost of $16,743,000. This amount is the sum of the estimated cost for navigation only, and of the cost common to navigation and power, as given in Columns I and II, Table E, of Capt. Ferguson's report. The United States could then rent or lease to the highest bidder or bidders the power at each high dam, the successful bidder to install the power-house superstructure and electrical equipment. By an additional expenditure of less than 12 per cent of Capt. Ferguson's estimate, the United States would not only make a more profitable investment, but would retain a better control of the situation.

Very respectfully,

G. D. Fitch,
Lieut. Col., Corps of Engineers.

The Chief of Engineers, United States Army
(Through the Division Engineer).

[First indorsement.]

OFFICE OF DIVISION ENGINEER, GULF DIVISION,
New Orleans, La., July 29, 1912.

1. Respectfully forwarded to the Chief of Engineers.

2. The recommendations on Capt. Ferguson's report were based on the supposition that parties interested in developing power would be ready at any time to properly cooperate with the United States. This has proved fallacious. Col. Fitch's recommendation is regarded as good were it practicable under the law as it now stands, but this is doubtful. Owing to the delays which the United States will experience in this and other works of similar character, it is regarded as advisable, in cases where electric power may be developed in conjunction with navigation improvements, the United States be authorized to construct the works in such manner as to provide for development of hydroelectric power at the site, together with such incidental works for power installation as should be built at the time to avoid any later changes in the structures; and that the Secretary of War be authorized to lease power to companies or corporations upon such terms as may be considered equitable after due consideration of the original cost of construction, expense of maintenance, and a reasonable per cent upon the outlay. This would permit the United States to proceed at once with any desired construction without having to wait for an agreement of cooperation with other parties.

In most cases the companies desiring to cooperate will be found either lacking the requisite capital or existing only for promotion purposes, in either case the United States being subjected to delay and embarrassment in prosecution of the work.

3. The delay in forwarding this report was due to an attempt to ascertain more definite information concerning the character and purposes of the Alabama Interstate Power Co., but nothing definite has been learned.

LANSING H. BEACH,
Lieut. Colonel, Corps of Engineers,
Division Engineer.

LETTER OF ATLANTIC AND GULF PORTLAND CEMENT CO.

ATLANTIC AND GULF PORTLAND CEMENT CO.,
Ragland, Ala., July 1, 1911.

GENTLEMEN: As there seems to be some doubt as to the advisability of the United States investing the money necessary to make navigable the Coosa River between Greensport and Wetumpka, we wish to call your attention to some of the salient features of this very necessary improvement.

The removal of the obstructions between Greensport and Wetumpka would permit steamers from Mobile to ascend regularly via the Mobile, Alabama, and Coosa Rivers to Rome, Ga., a distance of 734 miles; while the Oostanaula and its tributary, the Coosawattee, would afford them still further navigation for a distance of 100 miles above Rome, thus placing an immense area in Alabama and Georgia in immediate communication with the Gulf of Mexico and opening up water communication with the extensive coal fields and iron beds and agricultural regions of the Coosa Valley.

The river is an exceptionally favorable one for improvement, since its mean depth is greater in comparison with its average width than most of the western rivers, and its banks and channels are generally well-defined and permanent. Sand and gravel bars are seldom found and, when found, are easily removed. From Greensport to Wetumpka the river is broken up into pools and eddies of navigable water, separated by reefs, shoals, and rapids, sometimes of very great extent, absolutely impassable at low water and dangerous in the best stages by reason of the crookedness of the channel ways and the ragged rocks to be found everywhere along their borders and in mid-stream, reaching to the surface even when the water is 40 or 50 feet deep. The navigable water found between Greensport and Wetumpka is broken up into stretches, varying in length from 600 yards to 6 miles, and varying in depth from 6 to 60 feet. The intervening shoals vary from single reefs a few yards long in the direction of the current, and extending from bank to bank, to long series of shoals from a thousand yards to 12 miles in length. These obstructions consist almost entirely of rock, very little gravel being found. The average width of the river between Greensport and Wetumpka is from 800 to 1,000 feet.

The country that would be materially and beneficially affected by the proper opening of this great river line by the removal of the above obstructions between the two points, being a distance of only 137 miles out of 815 and upward now navigable, is that portion of northwest Georgia lying between the Lookout Mountain on the northwest and the line of mountains embracing the gold belt on the southeast traversed by the valleys of the Chattooga, Conasauga, Coosawattee, Oostanaula, and Etowah Rivers and Big Cedar Creek, and their tributaries, all whose waters help to form the Coosa, embracing a population of over 350,000 and an area of at least 6,000 square miles, or 3,840,000 acres of land, which for its productiveness of soil and mineral resources is unsurpassed by any other region of the same extent in the United States, producing cotton of the finest grade for uplands, as well as cereals, tobacco, and all kinds of fruits. For the production of the latter, the hills and mountains seem peculiarly adapted. This region is also rich in coal, iron, manganese, barytes, and other minerals. That portion of northeast Alabama that would be greatly benefited by the improvement of the Coosa River is bounded by Raccoon Mountain on the northwest and the range of hills or low mountains running parallel with and distant from the line of river about 35 miles on the southeast; having a general direction from the northeast to the southwest and in Alabama containing a population of over 300,000 upon an area of about 7,000 square miles or 4,480,000 acres of land, not taking into this account any portion of the country on either side of the line traversed by the lower half or nearly 400 miles of the river. This section of Alabama is in richness of soil and mineral wealth equal to that of northwest Georgia, partaking much of the same nature besides having extensive and inexhaustible fields of bituminous coal from 2 to 10 feet thick of the very finest quality and suitable for all manufacturing purposes. The coal fields traverse the whole area of Alabama above described and are immediately by the side of the extensive beds of iron ore of several varieties and finest quality which traverse the same area of country with the coal fields. Sandstone, limestone, fire clay, and other minerals abound in quantities sufficient to supply all future ages.

The annual saving to the people along the line of river in having cheap transportation for their surplus products would naturally enhance the wealth and prosperity of the country at large. For want of this great thoroughfare millions of dollars worth of the best long-leaf pine, a great variety of oak, ash, walnut, cedar, cypress, and poplar, which could be turned into the best lumber, are now reduced to ashes or rot upon the ground. Of the lands along the line of this river, the greatest majority are of surpassing fertility and could be developed into the most productive agricultural sections in the country.

By developing the water power, to which this river is especially adapted, manufacturing interests would spring up all along the line. The tendency is now, as ever, to manufacture an article so near as possible to the source of its raw material. Alabama is destined to become the foremost iron and steel manufacturing State in the Union. At present there are inexhaustible beds of iron ore along the banks of the river which but await the means to develop them. As the center of the steel industry moves from Pittsburgh to Birmingham, which it surely will do, the mills of that great district will call for more and more raw material. With the iron beds and deposits of high-grade limestone laying side by side with coal fields of highest quality, this region with cheap water transportation will supply this raw material for years to come.

To call your attention to the fact that not only now is there a pressing need for a waterway through this rich and growing country, but that as early as 1870, at a time when this country lay crushed and benumbed as a result of the devastation of the recent war, those who were clear sighted enough to see the needs of the people and the great advantages to be gained by water transportation argued strongly in its favor and advocated for the immediate completion of the opening of the Coosa throughout its entire course.

The chief engineer of the Selma, Rome & Dalton Railroad, in his report of 1870, incorporated in the report of the United States Chief of Engineers for 1872, treating of the improvement of the Coosa River, says:

"The wonder is that this work has not been accomplished a long time ago. Indeed, what channel of transportation is better calculated to spread all around industry, prosperity, and wealth? Capital and cheap transportation are wanted to make this section of the country an immense workshop capable of giving employment to thousands of mechanics and workmen and turning out every year millions of dollars worth of products of all descriptions. On the immediate banks of the river are found heavy and inexhaustible beds of iron ore and all the material necessary for its manufacture—coal, limestone, fire clay, and fireproof stone—in the greatest abundance. Judging from the experience of every country under similar circumstances, what an immense economical revolution this new channel of communication (with through transportation once opened) must produce in the country at large and particularly in the States of Georgia and Alabama and those immediately contiguous thereto. The climate of the Coosa Valley is salubrious, mild, and temperate; its winters are of short duration; its soil rich and productive; besides the staples, everything in abundance which is necessary to make living cheap for workman, laborer, and mechanic. This great valley is intersected by a large number of streams which never freeze, and on them are a multitude of sites for mills and factories with inexhaustible water power, and are destined one day to be the customers and feeders of this great channel. It is almost impossible to estimate the value of these lands, which will be the natural and immediate result of opening the river to navigation. It is fair to suppose, however, that the increase will be many times greater than the amount necessary to pay for all of the required improvements."

How much more pressing are the present needs can well be conjectured.

The South is the land of opportunity; the Promised Land of the young men of this generation as was the West to our fathers. The railroads recognize this fact, as they are spending thousands of dollars in exploitation of this virgin country. The days of the great plantations are passing; the land is being divided into manageable portions and the man of small capital but indomitable energy has arrived and has attracted the eyes of the world to the results which he has accomplished. Can the Government refuse to help him in his struggle and give him an outlet for the fruits of his labor?

Yours, respectfully,

Clarence N. Wiley, *Chief Chemist.*

The Board of Engineers for Rivers and Harbors.

Letter of Hon. Geo. W. Taylor.

Washington, D. C., *October 30, 1911.*

Gentlemen: In my impromptu remarks on the Coosa River project the other day I overlooked some points which may prove of interest.

River and harbor improvement is practically a fixed policy of the Government, though not fully recognized as belonging to the annual budget. The sooner this is done the better for wise administration.

Under this policy, especially when annual appropriations are assured, the best river systems should be the first to be cared for and taken up. The Coosa, and its tributaries and connecting rivers with the Gulf, is easily one of the five chief river systems in the United States. The importance has been recognized since 1826 by governmental aid. It is already on the docket of approved projects.

That water navigation is a good business might be assumed. It is demonstrated to be the business judgment of all progressive nations, and is being pushed and soon will be rushed in the United States. The opinion of England is fully expressed in the building(?) of the Manchester Canal, 35 miles long, at a cost of $75,000,000, or over $2,000,000 per mile. The canalization of Holland and Germany scarcely need citation.

The States in 1812 attempted river improvement and fell down. The Ste Sault Canal is a notable instance. It bankrupted Michigan, that splendid State, with the then enormous cost of $5,000,000—a bagatelle now. Michigan threw it off and the United States took up the burden and finished it. The cost was great, but who doubts it was worth all it cost and is worth all that is still contemplated.

A canal is now proposed from New York to Philadelphia by the Raritan River, abandoning the old canal, at a proposed cost of $50,000,000, and this is only the initial cost of about 100 miles. The proposition includes going out to the ocean via the Chesapeake Bay, the cost of 15 miles, the last cut to the Chesapeake, being $15,000,000, as estimated, or $1,000,000 per mile.

The Coosa from Rome to Mobile gives over 800 miles of navigation. The valley and its value has been estimated by the railroad interests as worth two intersecting railroad lines, and others are projected. Suppose a railroad could be built from Rome down the center of the valley for $15,000,000, how long do you think private capital would hesitate to make the investment?

The heavy freight of the Coosa Valley is demonstrated by the carefully weighed report of Mr. W. P. Lay to be worth now such an investment. Eight hundred miles of canal is worth more for heavy freight seeking outlet to foreign ports than two double-track railroads. Else why does New York put $101,000,000 in a canal?

The canalization of the Coosa at $15,000,000 means a cost of $18,750 per mile, the cheapest 800 miles of transportation within my range of information. This seems to settle effectually the question of cost and worth.

The Alabama River must be deepened to 6 feet. It can only be done by locks, unless the upper river is thoroughly improved and storage reservoirs are provided. The cost of locking fromWetumpka to Mobile can scarcely be less than $2,000,000. Any plan of improvement which eliminates locking over this section of the Coosa system is entitled to be credited with this $2,000,000. In other words, in considering storage reservoirs the locking of the Alabama River should also be estimated, or, rather, the elimination of locks thereon should be a part of the cost of storage reservoirs.

Storage and its possibilities have been discussed long enough. It is time to make an experiment. It seems that nature has fixed the best place for this experiment in the headwaters of the Georgia tributaries to the Coosa, by furnishing the tremendous precipitation of 70 inches of rainfall, together with an abundant and sufficient watershed, and extensive natural storage reservoirs requiring the least artificial assistance to restrain and hold water for use for navigation and power. The cost of storage, estimated at $4,000,000, makes this 800-mile canal (for navigation alone) cost less than $20,000 per mile.

As suggested in my remarks, the question of storage reservoirs is up to the Army engineer.

The Ohio River improvement will soon call for $25,000,000 for storage reservoirs, and scarcely 50 miles additional navigation. What better proposition for trying the value of storage reservoirs can be found in the United States than the Coosa River system? If floods can be minimized the vast acreage of land in the basin subject to overflow which will be preserved will alone justify the expenditure of $4,000,000.

The water power, estimated at 300,000 horsepower, more or less, would alone justify the cost of the storage reservoirs at $4,000,000. This water power can be used by the Government if it chooses, or rented. A fair rental value after 10 years would be not less than $3 per horsepower, to be increased at periods of 10 years, as conditions permit. This would mean an annual income of $900,000 in round numbers, and at this rate the Government would be fully reimbursed in less than 16 years for the present outlay of $15,000,000, and forever thereafter would receive a steady income of $1,000,000 per year as the minimum. In 50 years the investment would have returned its full cost and put into the Treasury of the United States every dollar that has ever been expended in river and harbor improvements in Alabama from 1826 to the present day.

Such a proposition should be put on its feet at once and provision made to complete it in 10 years or less. Congress has long since given its endorsement to the improvement of the Coosa River system. It now only remains for the engineer department to work out the best plan, having in view not the present situation but the completion of this great work to its fullest potential force as a factor in transportation, to meet the growing demands of commerce in the Gulf of Mexico. The waste of power in the Coosa valley has gone on too long already. The immense natural resources of the Coosa valley have been lying undeveloped as long as the real good of the country can afford.

The iron, coal, bauxite, marble, agricultural products, and other values only need cheap transportation to the sea to enter into their proper place in furnishing wealth to the Nation.

If it paid and still pays Manchester to spend $2,000,000 per mile for transportation (navigation) to the sea, with her limited contributing territory, how can it be said that it will not pay the United States to expend $20,000 per mile for 800 miles of transportation (navigation), not to mention flood contract and reclamation of lands and potential energies of 300,000 horsepower in a region blessed with a prodigality of natural resources and alive with active American citizens seeking to develop them. Capital only awaits the verdict of the Army engineer.

Respectfully,

Geo. W. Taylor,
M. C., Alabama.

The Board of Engineers for Rivers and Harbors.

Letter of Lieut. Col. G. D. Fitch, Corps of Engineers.

War Department,
United States Engineer Office,
Montgomery, Ala., April 20, 1912.

Sir: Referring to the improvement of the Etowah, Coosa, and Tallapoosa Rivers, as contemplated in a report of a survey made under this office and submitted to the department, I have the honor to state that action upon this report is being withheld, it being understood that certain water-power interests have stated that they have not had full opportunity of presenting their views on the subject of cooperation in the matter of the improvement of these streams.

I am instructed by the department to investigate further the subject of local cooperation in the improvement of the rivers named and to afford those interested in this matter full opportunity to be heard and present any propositions that they may desire on the subject. Pursuant to these instructions, I beg to state that I will be pleased to meet the representatives of any interests which may be concerned at this office on May 20, 1912, for a complete discussion of the matter of cooperation by private parties. It is requested that those interested present at this meeting any statements, data, propositions, etc., they may desire to submit, as far as possible in writing.

In order to afford the greatest possible facilities to those who will visit this place, it may be stated that the entire day will be given to the discussion of this question. In other words, those arriving at any hour up to 5 o'clock will be heard at any time during the day most convenient to them.

I would appreciate an acknowledgment of this letter, together with a statement as to whether you will or will not visit this office on May 20. I would also appreciate your placing this matter before any other interested parties who may not be known to this office and who have not received a similar letter to this.

Very respectfully,

G. D. Fitch,
Lieut. Col., Corps of Engineers.

Mr. W. P. Lay, *Gadsden, Ala.*
Mr. James Mitchell, *Room 306, Bell Building, Montgomery, Ala.*
Mr. R. A. Mitchell, *Gadsden, Ala.*
Mr. W. T. Brown, *Ragland, Ala.*
The Business Men's League, *Montgomery, Ala.*

Letter of Mr. W. P. Lay.

Montgomery, Ala., *May 20, 1912.*

Dear Sir: After many years of efforts we have only very recently succeeded in interesting capital in the proposed cooperative plan for the development of both navigation and power on the Coosa River. The people whom we have succeeded in getting interested in this work are the Alabama Interstate Power Company.

I regret to say, however, that these people have not as yet had time to make a study of the situation sufficient to enable them to make any definite proposition, and they are also in the dark as to the recommendations of Maj. Ferguson, in his report, therefore, I respectfully request that these people be given 60 days further time for a study and investigation of this most commendable undertaking.

I also beg to request that owing to the importance of the great questions involved, that these people be allowed to take the matter up with the board of review, in Washington, direct, to the end that they may work together in outlining and agreeing on some plan of cooperation that may be mutually satisfactory to all interests.

I would respectfully ask, if it meets your views, that this request be submitted with your report, and that the Alabama Interstate Power Co. be given an opportunity to go before the board of review in Washington on this subject at some time within 60 days that might suit the board of review.

Hoping this may have your kind consideration, and thanking you for the opportunity of being heard on the subject, I am,

Yours, very truly,

W. P. Lay,
Chairman Coosa River Improvement Association.

Lieut. Col. G. D. Fitch,
Corps of Engineers.

LETTER OF ALABAMA INTERSTATE POWER CO.

ALABAMA INTERSTATE POWER CO.,
Montgomery, Ala., May 20, 1912.

SIR: Under date of April 20, you addressed a communication to the writer stating that you had been instructed by the department to investigate further the subject of local cooperation in the improvement of Etowah, Coosa, and Tallapoosa Rivers, and to afford those interested in this matter full opportunity to meet you and present any proposition that they might desire on the subject.

Pursuant to these instructions, you stated that you would be pleased to meet representatives of any interests which may be concerned, at your office in Montgomery on May 20, 1912, for a complete discussion of the matter of cooperation by private parties.

The Alabama Power Co., represented by the writer, has secured water rights, reservoir lands and sites for the development of water power upon the Coosa and Tallapoosa Rivers, with the intention of eventually developing power and distributing it electrically from both these streams. It has not yet been determined definitely upon which stream or at what point upon either the initial development will be made.

The physical data at the command of the company is as yet wholly inadequate to a determination of the technical questions involved. The purchase of land in the proposed reservoir sites, the changing of alignment of highways and railroads and similar matters are under negotiation.

Bearing upon any possible cooperation between the Government and this company in the erection and use of works incident to the development of power is the important question of the extent to which the company's developments will benefit the public in the improvement of navigation and water supply. As to this we are wholly in the dark.

We understand that the War Department has made extensive surveys, collated and systematized information and made a report with recommendations covering not only the questions of storage on the Etowah, Tallapoosa, and Coosa Rivers, but the effect upon navigation of thus regulating the stream flow. This information is not public. It is impracticable within reasonable limits of time for private interests to secure this information independently of the Government, and even if thus secured, it could not in the nature of things be accepted by the Government as the basis of Government cooperation.

We therefore regretfully reach the conclusion that at this time we are wholly unable, in the absence of knowing definitely what we ourselves propose to do on the one hand, and what can be accomplished for the benefit of the public on the other, to offer any suggestions as to a plan of cooperation between the Government and this company.

Generally speaking, the preliminary studies made by our engineers indicate that the construction of a high dam at Cherokee Bluffs on the Tallapoosa River will enable the flow of this river to be so regulated as to deliver to the Alabama River during periods of low water a sufficient volume of water to so increase its depth as to afford practicable year-round navigation upon that stream.

In this connection we have to present to you most earnestly the desirability, in the interests of all concerned, of there being made public the entire report of Capt. H. B. Ferguson of 1909 and 1910 on the Etowah, Coosa, and Tallapoosa Rivers, together with his recommendations, and all data, plans, drawings, maps, and estimates in connection therewith.

With the Government's reports before us, and definite studies of the power requirements completed, we should have a basis for presenting to the Government a definite and concise plan for our contributing to navigation and water supply in the hope that the Government will cooperate with the Alabama Interstate Power Co. in a just and equitable manner.

The spirit of this letter is to set forth our desire to reach a common basis for the intelligent analysis and discussion of this subject.

Respectfully,

JAMES MITCHELL,

Lieut. Col. G. D. FITCH,
Corps of Engineers.

LETTER OF ALABAMA POWER CO.

ALABAMA POWER CO.
Birmingham, Ala., January 3, 1913,

SIR: Please again refer to your letter to this company dated November 22, 1912, and our answer of December 2.

In undertaking to make a definite reply to your communication with reference to a plan of local cooperation between the Government and this company for the joint improvement of navigation and development of power on the Coosa River we must ask you to refer to this company's answer of May 20 to the invitation from Lieut. Col. Fitch of April 20, inviting us to a conference to discuss local cooperation in the improvement of the river named.

In the course of our letter to Lieut. Col. Fitch of May 20 you will find the following: "It has not yet been determined definitely upon which stream or at what point upon either the initial development will be made."

Subsequent to our letter of May 20 to Lieut. Col. Fitch, litigation ensued between this company and the Tallassee Falls Mfg. Co. et al., and other matters of a local nature developed on account of which it was impracticable to proceed with original plans to construct a power dam at Cherokee Bluffs on the Tallapoosa River, and as that litigation promised to be lengthy, and still does, we were forced to make the initial development at Lock 12 on the Coosa River, where the Alabama Power Co. was granted a permit in a bill passed by Congress on March 4, 1907, to erect a dam.

In order that you may fully appreciate the serious difficulties with which we have been confronted in carrying forward the originally planned constructive purposes, we beg to advise you that the Alabama Interstate Power Co. entered into a contract with the American Cyanamid Co. to supply that company with power from the proposed Cherokee Bluffs development. When such development was necessarily deferred, and as the primary power developable at Lock 12 on the Coosa River would not be sufficient to fulfill the contract with the American Cyanamid Co., and at the same time supply the necessary power for public distribution which this company had undertaken to deliver, and in order to carry out the contract with the American Cyanamid Co., Senate bill No. 7343 was introduced in the Senate on July 20, 1912, by Senator Bankhead, and this bill was finally passed by Congress, on August 22, 1912.

To our great disappointment, the President, on August 24, 1912, vetoed the bill passed by Congress, thus making it practically impossible to fulfill the contract with the American Cyanamid Co.; in fact, the President's veto so seriously changed and discouraged our original program as to inflict a serious hardship upon us, and has caused us to suffer great, and perhaps irreparable, loss.

In the formation, organization, and financing of our enterprise it was represented to the English financiers, who provided the necessary funds, that the general dam laws as passed by Congress in 1906 and amended in 1910 were the laws that fixed the policy of the United States as governing joint navigation-power projects in the navigable streams of Alabama, which might invite private enterprise and investment, and that under these laws permits from the Federal Government could be promptly secured for the construction of dams in the Coosa River at those points where this company is the riparian owner.

As a reassurance to the stockholders, it was represented that the attitude and policy of the Federal Government as to the application of these laws was clearly set out in Circular No. 14, issued from the War Department by Gen. Mackenzie, then Chief of Engineers, on April 4, 1905, and attention was especially directed to the strong indorsement of the Hon. William H. Taft, then Secretary of War, who said, in part, on January 17, 1905, in his transmittal of Circular No. 14: "The report seems to me to be very comprehensive, accurate, and instructive."

This company, relying upon and believing in the good faith of the Government, projected its water-power development plan for carrying out its purpose to cooperate with the Federal Government in the improvement of the Coosa River. The President's veto of Senate bill No. 7343 has therefore destroyed and made impossible the constructive plans of this company.

Therefore, while this company has every willingness and sincerely desires to respond to your invitation to meet with you and discuss plans of cooperation in the improvement of the Coosa River, we believe that it will be clear to you after reading this letter and the printed documents herewith inclosed to you for your review that no plan of cooperation can be adopted under which this company can proceed with the construction of power dams in the Coosa River that may be approved by your department, since the Federal Government itself has refused, by the President's veto of Senate bill No. 7343, to permit this company to construct these dams, thus making any plans of cooperation at present impossible.

With your department, it is the sincere purpose of this company to cooperate in every possible way to carry forward these joint developments, and we shall be very glad indeed to send a representative to discuss this important subject with you upon any date that may be agreed upon as mutually convenient, and it will be an infinite relief from the difficulties and discouragements that now confront us, and from which we are suffering great loss, if perhaps you may fortunately suggest a plan of cooperation that may be, with the consent of the Federal Government, constructively carried out.

We shall appreciate any suggestions you may make, and in such event will very promptly arrange to have a representative meet you on any date and at any place that you may find it convenient to name.

Very respectfully,

W. W. Freeman,
Vice President and General Manager.

Maj. Earl I. Brown,
Corps of Engineers.

Letter of Maj. Earl I. Brown, Corps of Engineers.

War Department,
United States Engineer Office,
Montgomery, Ala., January 9, 1913.

From: Maj. Earl I. Brown, Corps of Engineers.
To: The Chief of Engineers, United States Army.
Subject: Local cooperation, Etowah, Coosa, and Tallapoosa Rivers.

1. Referring to first indorsement and to letter from my predecessor, dated July 12, 1912, on the subject of cooperation by local interests on the proposed improvement of Etowah, Coosa, and Tallapoosa Rivers, I am transmitting herewith, at the request of the Alabama Power Co., a letter received from them recently setting forth the difficulties which have hitherto prevented them from formulating and presenting a definite plan of cooperation.

2. I have been assured by representatives of the company that they are very anxious to expedite this matter, but are unable to do so until they have more definite information as to what will be the policy of the Federal Government in regard to charges on power developed.

3. Although this company is amply able financially to carry out any plan of cooperation that may be agreed upon, the adoption of a policy as announced by the President in his veto message upon bill S. 7343, Sixty-second Congress, second session, will probably decide them not to undertake such cooperation.

Earl I. Brown.

Memorial and Statement of Facts of Mr. W. P. Lay et al.

Gentlemen: A notice was issued by G. D. Fitch, lieutenant colonel of engineers, in charge of the district embracing the Coosa-Alabama River, that your honorable board was unable to concur in the recommendation of Capt. H. B. Ferguson, former district officer, for the improvement of said river, for the reason that you did not believe that the probable benefits to general commerce and navigation likely to result from the improvement would be sufficient to justify the expenditure recommended in said report.

On receipt of this notice a meeting was called at Montgomery, Ala., to consider said notice, and the undersigned were appointed a committee to appear before your honorable body and present such facts as we hope may convince you that the probable benefits to commerce and navigation will justify the expenditure recommended in said report. In conformity with the purpose of our appointment we respectfully submit the following memorial and statement of facts:

The Coosa-Alabama River, in Georgia and Alabama, from the standpoint of water discharge, is the third largest stream in the South, and penetrates a region the combined richness of which in agriculture, manufactures, minerals, and other natural resources, in such close proximity to each other, so near the seaboard, is without a parallel in the world.

We beg to represent further that the products of this region are such that they are not only well suited but especially attractive for exporting, and while these products are now being exported to a limited extent, a much greater proportion, as we shall hereafter undertake to show you, are awaiting this trade.

We beg to represent to your honorable body still further that the Coosa-Alabama River is a great natural highway, both ends of which have been in successful navigation for almost a century, and that there would be about 800 miles of through navigation to the Gulf over this splendid stream were it not for a series of rapids about midway its length which cuts navigation in twain. Then further, penetrating as it does the great natural store of riches above mentioned, the effects of through navigation would be not only to develop a large local and intermediate traffic, but to give to these products a direct route of water transportation to the sea for export.

In view of the inevitable impetus that will be given the export trade from the southern coast by the opening of the Panama Canal, this fact becomes very significant.

We must therefore insist that the improvement of no other river now being considered by the Federal Government is more urgently needed or promises greater results than that of the Coosa-Alabama River in Georgia and Alabama.

COOSA-ALABAMA RIVER.

The Coosa-Alabama River has a drainage area of about 10,000 square miles, and from the standpoint of water discharge is the third largest stream in the South, being exceeded only by the Mississippi and the Tennessee, and its course to tidewater is direct and short. It rises in the Appalachian range of mountains, where, with the exception of one or two small areas in the States of Oregon and Washington, the precipitation of rain is the largest in the entire United States, with good seasonable distribution and in which the topography is favorable for conserving or impounding the flood waters. It flows thence in a southwesterly direction along the folds of the disappearing Appalachian Range, on the high plateau of the Piedmont belt, through a region next in importance as to quantity of rainfall and perhaps unequaled for its numerous large, perpetual, gushing springs and small streams that contribute to its mighty force and volume, until about midway its length it passes off of the high plateau above mentioned over a series of great rapids, just east of Birmingham, between Gadsden and Montgomery, Ala., into the coastal plain, through which it continues to wend its way on to the Gulf of Mexico at Mobile, Ala.

The great number of large, perpetual, gushing, limestone springs found in the upper Coosa-Alabama Valley is a geological sequence from the fact that, as the Appalachian Range of mountains disintergrate and disappear in Alabama, there is a large and thick residual accumulation forming the surface of the earth, highly porous, that absorbs a large portion of the heavy rainfall of this section. The result is these conditions create an earthen storage or reservoir, which forms the source of the thousands of large springs found in this part of the valley, many of which are so large that mills are run by their branches.

A careful study of the water discharge of the Coosa-Alabama River, covering over a period of a third of a century or more, demonstrates that as the years go by and the forests are denuded and the land put into cultivation contrary to the commonly accepted theory the floods have been reduced and the minimum discharge of this stream very materially increased.

This rather unusual condition can be accounted for with a degree of certainty in this way: The thick and highly porous condition of the earth's surface in the upper Coosa-Alabama River Valley, as the forests are cleared away and the land put into cultivation, the land being plowed and the surface thus being made more spongy, takes up more and more of the rainfall, hence the run-off is not so rapid, and as a result the impetuosity of the floods are decreased.

On the other hand, the increased quantity of rainfall so absorbed by the earth, being emitted through the thousands of large limestone springs, thus increasing the discharge of these springs throughout the entire year, the low-water or minimum discharge of this river is exceptionally large, all of which are most potent factors in navigation and the development of power.

On this condition in the upper Coosa-Alabama Valley Dr. Eugene A. Smith, State geologist of Alabama, in his treatise on "The Underground Water Resources of Alabama," says: "While the rocks of this subdivision are not as a rule characterized by any serviceable degree of porosity, as will be seen later, yet they are all covered more or less completely by soils and other residual matters resulting from their decay and weathering, and these surface accumulations are fairly well adapted to the absorption and storage of the rainfall, so that springs and open wells are common throughout the area."

Dr. Smith also says: "Of much greater importance in this connection are the great limestone springs, or big springs, especially of the Knox dolomite and in less degree of the Tuscumbia (Lower Carboniferous) limestones. Both these limestones in some parts are highly siliceous or cherty, and like all limestones are traversed near the surface by fissures, channels, and caverns, formed or enlarged by the solvent action of the circulating waters, which also, dissolving the purer parts of the limestone, leave behind the chert in great open masses of the highest degree or permeability. In consequence of these conditions much of the rainfall in these terranes finds its way sooner or later into the subterranean channels forming streams which emerge as big springs. It would be hardly possible to enumerate all the great limestone springs of this section."

The fact is, there is not a river in the United States on the headwaters of which the precipitation of rain is as large as that on the headwaters of the Coosa-Alabama, except two or three small rivers that emanate from the same region, neither is there a river in the United States that flows through a district at all comparable with that of the upper Coosa-Alabama Valley for its thousands of great limestone springs, tributary to this stream before it passes off into the coastal plain, hence the phenominally large minimum discharge of this river as compared with other streams emanating from mountainous regions.

The upper portion of the Coosa-Alabama River from away above Rome, Ga., down to the head of the rapids above mentioned, a distance of about 250 miles, has been in successful navigation with light-draft boats for about 75 years, while the lower end, from the foot of the rapids to the Gulf of Mexico has been navigated for about 100 years. There would be a continuous route of navigation over the entire length of this river, a distance of about 850 miles, were it not for the rapids about midway its length that cut navigation in twain. However, the navigation on both these sections of the river are more or less disturbed during low-water periods, which does not last over 60 to 90 days, and this only occurs every few years.

Former presentations verified.—In our efforts to get the Coosa-Alabama River opened to through navigation to the Gulf of Mexico, about 11 years ago, we compiled the resources of the Coosa-Alabama River Valley and presented it to the Congress of the United States in the form of a memorial. Since that time a supplement to this memorial was prepared, which has been used to a limited extent in advocating the opening of this stream to through navigation. The information contained in these presentations was compiled with a great deal of care and in the course of time the correctness of the claims made therein has been surprisingly well supported, and it is very interesting to note the wonderful progress made in the Coosa-Alabama River Valley in the past 11 years, by a comparison of these various compilations. Therefore, we shall not only take the privilege of quoting from these memorials right liberally, but we beg to resubmit them and ask that they be made a part of this presentation.

COOSA–ALABAMA RIVER VALLEY.

There are 25 counties in North Georgia and Alabama directly tributary to and forming the Coosa-Alabama River Valley. For convenience in this presentation we shall divide this valley into two sections, designating the section from Wetumpka, at the foot of the rapids up, as the upper Coosa-Alabama Valley, and from Wetumpka to the Gulf, through the coastal plain, as the lower part of the valley.

While the benefits to be derived from the opening of the Coosa-Alabama River to through navigation to the Gulf of Mexico is national in its scope, and all Alabama, North Georgia, and a part of Tennessee will be directly benefited by this much-needed improvement, yet we shall rest our claims for the improvement of this stream chiefly upon the commerce and demands of these 25 counties.

The climate of the Coosa-Alabama River Valley is mild and salubrious and the land wonderfully fertile. It possesses a population of about 750,000 happy souls, and they carry on diversified farming in every part of the valley with the most gratifying success. Cotton, corn, wheat, oats, and stock are the principal products of the farm, cotton especially, for practically speaking, it is one vast cotton field from one end to the other, though almost every plant and vegetable that grows in the temperate zone is found here, and they inevitably thrive in proportion to the attention bestowed upon them. Manufacturing of every variety is also carried on very extensively, and the increase in this branch of industry for the past 10 years has been marvelous and the mineral resources of the valley are almost beyond conception.

MINERAL RESOURCES.

It is safe to say that there is found in the Coosa-Alabama River Valley the greatest combination and variety of rich and valuable minerals, in the closest proximity to each other, nearest the seaboard of any part of the United States, and as we say, it is probably without a parallel in the world. Gold is found in Tallapoosa County and elsewhere, and at one time attracted a large population. Kaolin, yellow ocher, graphite, mica, and barite all appear in commercial quantities. Bauxite, or aluminum, ore is found here in great purity, and this is found in only one other place in the United States, but the predominating minerals found in the Coosa-Alabama Valley are, coal, clays, shales, and limestone for cement making, marble, red, brown, and gray iron ores, and limestone for fluxing and fertilizing purposes.

MARBLE.

The marble of this valley is of an extra fine grade and is simply inexhaustible. This deposit of marble begins right on the bank of the Coosa-Alabama River in Talladega County and extends in a northeasterly direction about 60 miles. It forms what is known as the "marble valley," and is 3 to 4 miles wide and estimated to be about 1,200 feet thick. This marble is now being extensively and profitably worked and those engaged in its development are anxiously seeking water transportation for this product to the Gulf.

LIME.

When we take into consideration the extent to which lime is used in the world's progress, in connection with the fact that the lime deposits of the upper Coosa-Alabama River Valley are probably the richest and most extensive to be found anywhere in the United States, we can realize that this product demands more than a passing thought. Besides the use of lime for domestic purposes and sanitation, and regardless of the present rate of freight, large quantities of lime are now shipped from the upper Coosa-Alabama Valley to the sugar refineries of Louisiana and the West Indies, where it is used very largely in the refining of sugar, and this market begins right where the waters of the Coosa-Alabama River, the object of this presentation, empty into the Gulf of Mexico.

Lime is also a very valuable fertilizer for the sugar plant grown in Louisiana and the West Indies, but the present freight rates from the upper Coosa-Alabama Valley to this region make it impossible to reach this class of trade. If the Coosa-Alabama River were opened to through navigation to the Gulf, so river rates could be obtained, the tonnage on this product for a fertilizer would consequently be very heavy.

CEMENT.

The towering ranges of cliff-limestone of the upper Coosa-Alabama Valley, hanging over the river and valley hundreds of feet high, assay 98 to 100 per cent pure lime. This limestone is intermingled with inexhaustable beds of all the clays and shales necessary for the manufacture of a high-grade Portland cement. While these rich, raw materials exist in absolutely inexhaustable quantities, this branch of industry is yet in its infancy in this region, but is fast assuming proportions in keeping with its importance.

One of the big cement plants of this region that sits practically right on the bank of the Coosa-Alabama River at Ragland, Ala., is now anxious to enter the export trade, and they have advanced a very original and unique plan for the exportation of their product. Cement, as is well known, is liable to damage and deteriorate when it is kept over any length of time or when shipped by ocean transportation. To overcome this trouble it is the purpose of these cement people to prepare, mix, and burn the cement material at their Ragland plant and ship this cement material in the clinker, unground, in bulk, and store and grind it at the points to which it is shipped as it is needed. By this means they will avoid water damage or deterioration entirely, as the material will not damage or deteriorate while in the clinker form.

If the Coosa-Alabama River was opened to through navigation to the Gulf, this plant alone would now furnish 100 tons of commerce per day for export.

In support of this assertion, we attach hereto a letter from Mr. W. B. Schaeffer, president of the Atlantic & Gulf Portland Cement Co., of Ragland, Ala., the company that desires to make such shipments. The letter will explain itself, and we beg that you refer to same in connection herewith.

IRON ORE.

The available iron ore in sight within 40 miles of the Coosa-Alabama River is now estimated by experts at 1,075,000,000 tons. In addition to this, new discoveries are not only constantly being made, but as the work in the ore mines now in operation penetrate deeper into the earth all former estimates are invariably increased.

IRON AND STEEL INDUSTRY.

The iron and steel industry of the Coosa-Alabama River Valley is now very extensive and increasing with great rapidity. Cast-iron pipe, stoves, and many other iron and steel products, all well adapted for export, are now very extensively shipped from this region, and the valley enjoys the distinction of being one of the very few sections of the United States in which the iron ore is taken from the earth practically from right under the shadow of the smokestacks of the great iron and steel furnaces and converted into finished iron and steel products ready for export to all parts of the world.

This economic and complete process of conversion is carried on by the Southern Iron & Steel Co. at its Gadsden, Ala., plant, which is located on the Coosa-Alabama River above the rapids on this stream.

The products of this great and complete plant consist of steel structural material, steel barbed and woven-wire fence, and steel-wire nails, and are taken from the iron ore and converted into these commodities all within one inclosure at the rate of 1,000 tons per day. These products are all attractive for export, and the only thing now left to make this one of the most complete plants in the world in all of its relations is the opening of the Coosa-Alabama River to through navigation, so as to give the great mass of freight produced by this splendid plant water transportation to the Gulf for export, which it might be proper for us to say in this connection was the primary object in view when this plant was designed and built at this particular locality.

If the Coosa-Alabama River can be opened to through navigation to the Gulf, it is the purpose of the owners of this great iron and steel industry to make Mobile, Ala., the distributing point for all their products. To do this, it is their purpose not only to build large storage warehouses at Mobile from which to ship their products to all parts of the world, but to build boats and barges of sufficient capacity to transport these products from their plant at Gadsden to Mobile. This would give, to be handled on this river from this plant alone, 1,000 tons per day.

In support of these assertions we attach hereto a letter from the Hon. Cecil A. Grenfell, chairman of the executive committee of the Southern Iron & Steel Co., to which we call your special attention.

While we have mentioned a few of the principal commodities of the Coosa-Alabama River Valley that are now seeking water transportation to the Gulf for export, they are not by any means all. Cotton, cotton seed, cotton goods are now largely exported from this section, while cast-iron pipe, clay pipe, brick, stoves, and many other products are exported only to a limited extent. In all of these, the export trade could be largely benefitted and very materially increased by the opening of this river to through navigation to the Gulf.

Hereto attached are a number of photographs showing the products of the Southern Iron & Steel Co., of Gadsden, Ala., in their various stages of manufacture, from the iron ore to the finished products ready for export.

There are also hereto attached photographs showing parts of other manufacturing plants of the Coosa-Alabama River Valley, the products of which are waiting water transportation to the Gulf for export, together with several photographs showing scenes of navigation both above and below the rapids on this stream. These latter photographs will give some idea of the extent to which navigation is now being carried on irrespective of the fact that this river is tied up in the middle.

There is also attached hereto a map showing the average precipitation of rain throughout the United States, which will verify the claims made herein as to the precipitation, while Dr. Eugene A. Smith, State geologist of Alabama, a very high authority, is liberally quoted in support of the claims made herein as to the great number of large perpetual gushing limestone springs found in the upper Coosa-Alabama River Valley, all of which we pray that you make a part of this presentation and refer to same as often as in your wisdom you see proper.

PRESENT PRODUCTION AND TONNAGE.

It was our purpose and desire to lay before your honorable body a complete compilation of the commerce of the entire Coosa-Alabama River Valley reduced to tons and value, but we regret to say that we have been unable to obtain the tonnage of the lower part of the valley with any degree of accuracy, therefore we herewith give you the annual tonnage of the upper part of the valley in detail, and estimate that of the lower part of the valley from Wetumpka to the coast.

The annual production of the upper Coosa-Alabama Valley, though still in its incipiency as compared with the natural resources of this region, is as follows:

	Tons.	Value.
Cotton	55,165	$13,239,600
Cotton seed	110,330	2,206,600
Grain	409,725	9,105,000
Cattle, sheep, and hogs	25,000	1,000,000
Cotton-mill products	56,430	22,015,000
Iron and steel products	992,000	14,855,000
Other manufactured products	1,536,400	52,651,000
Iron ore	1,750,000	2,625,000
Other minerals	50,000	150,000
Lime	750,000	525,500
Marble, 120,000 cubic feet	10,800	420,000
Coal	520,000	780,000
Coke consumed	814,000	1,628,000
Timber cut	555,750	2,006,000
Cement, 475,000 barrels	95,000	475,000
Fertilizers	67,000	1,340,000
Brick (paving)	225,000	900,000
Total	8,022,600	125,921,700

RESOURCES OF THE UPPER VALLEY.

Comparison, 1899–1910.

By referring to page 17 of the original Coosa River Memorial of September 27, 1899, a copy of which is hereto attached, it will be seen that the visible tonnage produced in the upper Coosa-Alabama River Valley at that time was 3,861,525 tons per annum, valued at $52,816,000.

Thus we have the following comparison for the 11-year period ending December 31, 1910:

Year.	Tonnage.	Value.
1910	8,022,600	$125,921,700
1899	3,861,525	52,816,000
Gain in 11 years	4,161,075	73,105,700
Per cent	108	138

In support of this tabulation we beg to refer you to the Manufacturers Record of date August 17, 1911. This journal gives the increased production in all Alabama for the year 1910 over the year 1900 at 103 per cent.

As we are forced to estimate the tonnage of the lower Coosa-Alabama Valley from Wetumpka to the coast, and to enable you to realize more fully the importance of the commerce of this section, we shall quote from the reports of Capts. J. B. Cavanaugh and H. B. Ferguson, two well-known and able United States engineers, formerly having charge of the district through which this river flows.

Capt. Cavanaugh, now Maj. Cavanaugh, in speaking of the lower Coosa-Alabama River, in his report of 1906 says: "The commerce of this stream is important, consisting principally of cotton, cotton seed, fertilizers, grain, lumber, shingles, naval stores, staves, and a large quantity of miscellaneous freight of all descriptions."

Capt. Ferguson, now Maj. Ferguson, in his report of 1908 practically reiterates the remarks of Maj. Cavanaugh.

It would be approximately correct to say that the commerce of the upper and lower Coosa-Alabama Valley are about equal in importance and value, but the tonnage of the lower part of the valley is probably about two-thirds that of the upper valley.

Conceding this estimate to be about correct, this gives us, produced in the Coosa-Alabama Valley annually, a total tonnage of 13,371,000 tons, valued at $251,843,400.

RETURN FREIGHTS.

In the ordinary exchange of commerce in return for these vast resources we must naturally have almost a like amount in value returned to the Coosa-Alabama Valley, though the articles so returned being in a more refined state, the tonnage on the incoming goods would probably be about half that of the outgoing. This gives us to be handled in the Coosa-Alabama Valley annually at the present time 20,056,500 tons of commerce, valued at $503,686,800.

FUTURE INCREASE.

As we have undertaken to show you herein, the commerce of the Coosa-Alabama River Valley has more than doubled within the past decade, and with the stimulus that is destined to follow the opening of the Panama Canal the increase in the future of this section lying so favorably to the Gulf coast will undoubtedly be very much greater than that of the past, and especially will this be the case if the Government of the United States declares it its purpose to open the Coosa-Alabama River to through navigation to the Gulf.

If the United States Government were to-day actively at work on this river, with a definite and fixed plan for its improvement, it would hardly be possible for it to accomplish this task within a shorter period than from 10 to 12 years, and by that time, judging the future by the past, giving proper allowance for the stimulus that would be given this section in view of the opening of this river to the Gulf, in connection with the opening of the Panama Canal, the total commerce of the Coosa-Alabama River Valley, including the incoming freights, would reach the enormous proportions of not less than 36,000,000 tons per annum, valued at $900,000,000.

PROPORTION ALLOTTED RIVER.

It is hard to say just what percentage of this commerce would be handled on the river were it opened to through navigation to the Gulf, but it has been estimated on several occasions that 20 per cent would be so transported. In view of an export trade which we deemed inevitable from this region, 11 years ago when we compiled the original Coosa River memorial, we estimated then that 20 per cent of the commerce of this valley was destined to be handled on this river, were proper navigation facilities extended through to the Gulf. We beg now to say that time has strengthened our belief in the correctness of this proportion, for the rapidly increasing export trade in recent years, and in view of the stimulus that will be given this trade by the opening of the Panama Canal, together with the great stores of commerce that are now knocking at the gateways of this river for transportation to the Gulf for export, we think fully justifies this estimate.

Conceding these estimates to be approximately correct, were the Government actively at work to-day, with approved and fixed plans for the improvement of this river before this task could possibly be accomplished, the proportion of commerce that would be ready for transportation over this great water highway, including intermediate freights, as well as freights to and from the Gulf port, would be approximately 7,200,000 tons per annum.

This would give 19,727 tons daily to be handled on this river, and would require 66 steamers or 66 barges per day of 300 tons burden each.

It may be claimed that the foregoing conclusions are visionary, but when we take into consideration the great stores of natural resources found in the Coosa-Alabama River Valley, so favorably situated for exporting, and judging the future progress of the valley by the past, together with its present demands, we must insist that our conclusions are not overdrawn.

In support of the above conclusions we attach hereto a supplement embracing not only large amounts of commerce guaranteed to be handled on the river if the Government will open it to through navigation, but also guaranteeing modern wharves at Rome, Ga., Gadsden, and Ragland, Ala., to which we call your special attention. In this connection we also beg to again call attention to the letters of Hon. Cecil A. Grenfell and Mr. W. B. Schaeffer hereto attached.

IMPROVEMENT OF NAVIGATION BY STORAGE.

The improvement of navigation on inland rivers by conserving or impounding the flood waters in reservoirs has proved to be a great success wherever tried, and this mode of improvement is now attracting very favorable attention.

This plan of improvement is a source from which three great and lasting benefits may be derived, and these are:

First. The improvement of navigation.

Second. The amelioration of flood conditions.

Third. The increased development of power, where water power is possible.

In all cases where rivers have been improved by reservoiring we find that the benefits to navigation have not only been most gratifying, but that the impetuosity of the floods has been decreased, hence the benefits from this character of improvement are, in this way, invariably twofold, and where water powers are possible, the benefits would be threefold.

We understand fully that the Government of the United States can only be interested in navigation, but where conditions are favorable, and there is nothing to be lost and all to be gained by a triple development of this kind, good stewardship would demand that this character of improvement be made.

The Inland Waterways Commission, after a careful study of the various plans for the improvement of our rivers, not only indorse the reservoir plan of improvement most heartily but recommends that the improvement of the Ohio be largely accomplished in this way.

The Upper Mississippi River Improvement Association, recognizing the great benefits to navigation, as well as the amelioration of the flood conditions that have been accomplished by the limited storage system at the head of the Mississippi, now strenuously advocates the enlargement of the reservoir system for the improvement of this stream, and says that it is "the most important question that can come before the association."

Thomas and Watt tells us that the reservoir system at the heads of the Volga and Msta Rivers in Russia are a great success in both navigation and the amelioration of the flood conditions, and we are often pointed to this development as a model.

Why should Russia be held up as a pattern for the balance of the world for her model river improvement when it conserves only two of the benefits which many of our waterways are capable of bestowing upon a people? Why not the United States take the initiative in a model triple development and set an example for the balance of the world? The Coosa-Alabama River in Georgia and Alabama is an ideal stream for such a development, for its tributaries, cutting through the mountains of north Georgia, form three desirable reservoir sites at which reservoirs can be economically developed of sufficient capacity not only to relieve the impetuosity of the floods, but to maintain, with some light jetty work, from 7 to 8 feet of navigation on the flat parts of this river both above and below the rapids on this stream at all times, as well as to treble the already large water-power possibilities where this river passes off over these rapids into the coastal plain.

The reservoirs at the head of the Volga and Msta Rivers in Russia, that have been so successful in aiding navigation and the amelioration of the flood conditions on those rivers, we are told have a capacity of 35,000,000,000 cubic feet of water.

One of the three reservoirs on the head of the Coosa-Alabama River has a capacity of 42,000,000,000 cubic feet of water.

There is a very wide difference in the cost of impounding reservoirs. They cost all the way from 50 cents to $400 per acre-foot. The average cost seems to be from $10 to $20 per acre-foot. It is estimated that the principal reservoir on the head of the Coosa-Alabama River will cost $4 per acre-foot.

In support of these averments we cite you to the report of the Inland Waterways Commission of 1908, and also to the report of the Board of United States Engineers, consisting of Maj. H. M. Chittendon, Maj. Charles L. Potter, and Capt. W. B. Judson, found in the report of the Chief of Engineers of the United States, 1906, and to B. F. Thomas and D. A. Watt on the Improvement of Rivers, and James Dix Schuyler on Reservoirs.

WATER POWER.

The fall in the Coosa-Alabama River from Greensport, Ala., to Wetumpka, the section in which the rapids occur in this river, is 370 feet in a distance of 142 miles. The big rapids on the river, however, are from the head of Weduska Shoals, about 10 miles below Talladega Springs, to Wetumpka. In this section the river falls 250 feet in 48 miles. The amount of power that can be developed from the fall and the water discharge over the rapids on this river without the conservation of the flood waters is about 150,000 horsepower.

It is true the development of water power is appurtenant to State and riparian ownership and not within the jurisdiction of the United States Government. But, if the plans for the improvement of this river are designed with the view of developing the water power of the stream in connection with its improvement for navigation, and the Government of the United States will take proper cognizance of the water-power rights on the river and cooperate with individuals or capital in a liberal policy for a dual development of both navigation and power upon such terms as would be equitable, right, and just to all interests concerned, great economy can be accomplished in both the improvement of the river and its operation thereafter.

In addition to this the development of water power in connection with the improvement of this river for navigation would make the whole system, we might properly say, reciprocal in its effects, from the fact that the commerce that the water powers would be capable of producing right on the bank of the river, and which they would undoubtedly be producing in a very short time, would largely, if not wholly, justify the Government in its expenditure for the improvement of navigation.

Raw material, energy, and transportation are the three principal factors of all industrial progress. It will be observed that the Coosa-Alabama River itself can most effectively and economically supply two of these essential factors, energy and transportation, while the third, raw material, abounds in the greatest profusion.

As we have hereinbefore undertaken to show, the upper Coosa-Alabama River Valley is rich from one end to the other with all the minerals necessary for the manufacture of iron and steel, and it passes within easy reach of the Great Birmingham district, in which these natural resources are found in great quantities.

The entire valley is also, practically speaking, one rich and vast cotton field, the plant of which not only demands a great deal of fertilizing, but inevitably yields in proportion to the rich fertilizers bestowed upon it.

The most modern mode of producing iron and steel for their uses and nitrogen for fertilizers is accomplished by electricity generated by water power, and this promises soon to become the most economic way of producing these commodities. Therefore, the abundance of rich raw material for iron and steel making in such close proximity to the great water power possible on the Coosa-Alabama River, the manufacture of iron and steel, and the manufacture of the finished products of iron and steel by electricity generated by the mighty force of this stream is destined to be a great factor in the new era for the manufacture of these commodities.

Then, too, with the world dependent on the South for cotton with which to clothe the people, the manufacture of atmospheric nitrogen for fertilizers right in the midst of the cotton field is a consummation devoutly to be wished by the world at large.

If there is any one branch of industry that needs stimulating right at this particular time it is agriculture. The manufacture of nitrogen for fertilizers by the water that is now going to waste over the great rapids on the Coosa-Alabama River, right in the midst of the cotton field, where, by the use of this nitrogen four bolls of cotton may be grown where we now grow one, and other things in proportion, the employment of a part of this power in this branch of industry, as well as in the fabrication of the cotton itself, promises the most gratifying results.

INDUSTRIAL PROGRESS.

The industrial progress of the United States has reached a stage where its production is so far in advance of its home market that it must now look out for a more liberal share of the world's trade than ever before, and this, too, comes right at the time when competition was never more sharp or keen. Among the many commodities that are now being produced so largely in excess of our home market are iron and steel products, such as abound in the Coosa-Alabama Valley. While these commodities are being produced so largely in excess of our own home market, we find the Pacific slope of our country being invaded by Chinese iron, made by the cheap labor of China, costing probably not over 10 cents per day. The Pacific slope has placed only recently large orders with Chinese merchants for iron made in China, the delivery of which is to cover over a period of seven years. The question arises now, how are we to meet these conditions and overcome them. One thing that will largely relieve this situation is to open the navigable rivers from the great iron and steel districts of Alabama to tidewater so as to give this rich and fertile section cheap water transportation to the coast for export, thereby enabling this region not only to better meet the competition of China on our Pacific slope through the Panama Canal, but to dispose of its products more liberally in foreign markets, which would soon take Alabama's great stores of commerce largely out of competition with her sister States not so favorably situated for exporting and leave the latter to enjoy a more liberal home market.

While water transportation is of great advantage and very necessary in all classes of trade, it serves its greatest purpose when its use will aid, encourage, or stimulate an export trade.

A nation is rich or poor in proportion as the balance of trade is for or against it; therefore, a water highway which aids or encourages an export trade, bestows benefits that are nation wide, while one that serves a local purpose only bestows benefits that are more local. Both these purposes are very important and necessary, yet one is more of a national benefit, while the other is of a local benefit.

So thoroughly are these facts realized and appreciated by some of the European nations that they discriminate between their domestic trade and their export trade in favor of the latter.

Germany, for instance, a country that owns and controls both its rail and water highways, not only operates them so as to promote the development of the nation by adjusting rates so as to give the German manufacturer the advantage in his home market, but they make a difference between domestic and export rates in favor of the export trade. Then, too, the water highways of Germany have been improved until the water transportation facilities of that country are far ahead of the United States. As a result, with all these advantages, notwithstanding the fact that the natural resources and area of territory of the German Empire are not comparable with those of the United States, yet with such national encouragement as this, German exports now exceed those of the United States by over five hundred millions of dollars per annum.

The trade of the United States up to this time of its existence, comparatively speaking, has been almost wholly domestic; therefore, the trade lines leading to our own commercial centers have been most important and most liberally provided. The commercial progress of the United States, however, has now reached a stage where we must aid, encourage, and foster our export trade more than ever before, and to do this there is nothing that would contribute more to the upbuilding of this trade than the opening of our water highways, from the sections nearest and most convenient and favorable for this character of trade to the seaboard.

The present condition of the commerce of the United States demands this, and the future progress of the country demands it; therefore it is a national necessity, a national duty, a duty that our Government should feel was compulsory upon it to discharge.

Respectfully submitted.

W. P. LAY.
J. M. ELLIOTT, Jr.
FRANK D. KOHN.
GORDON LEE.
J. W. HANCOCK,
Mayor, City of Rome, Ga.
JOHN L. BURNETT,
Member of Congress, Seventh Alabama District.

OCTOBER 26, 1911.

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS.

INDEX OF ILLUSTRATIONS.

MAP 1

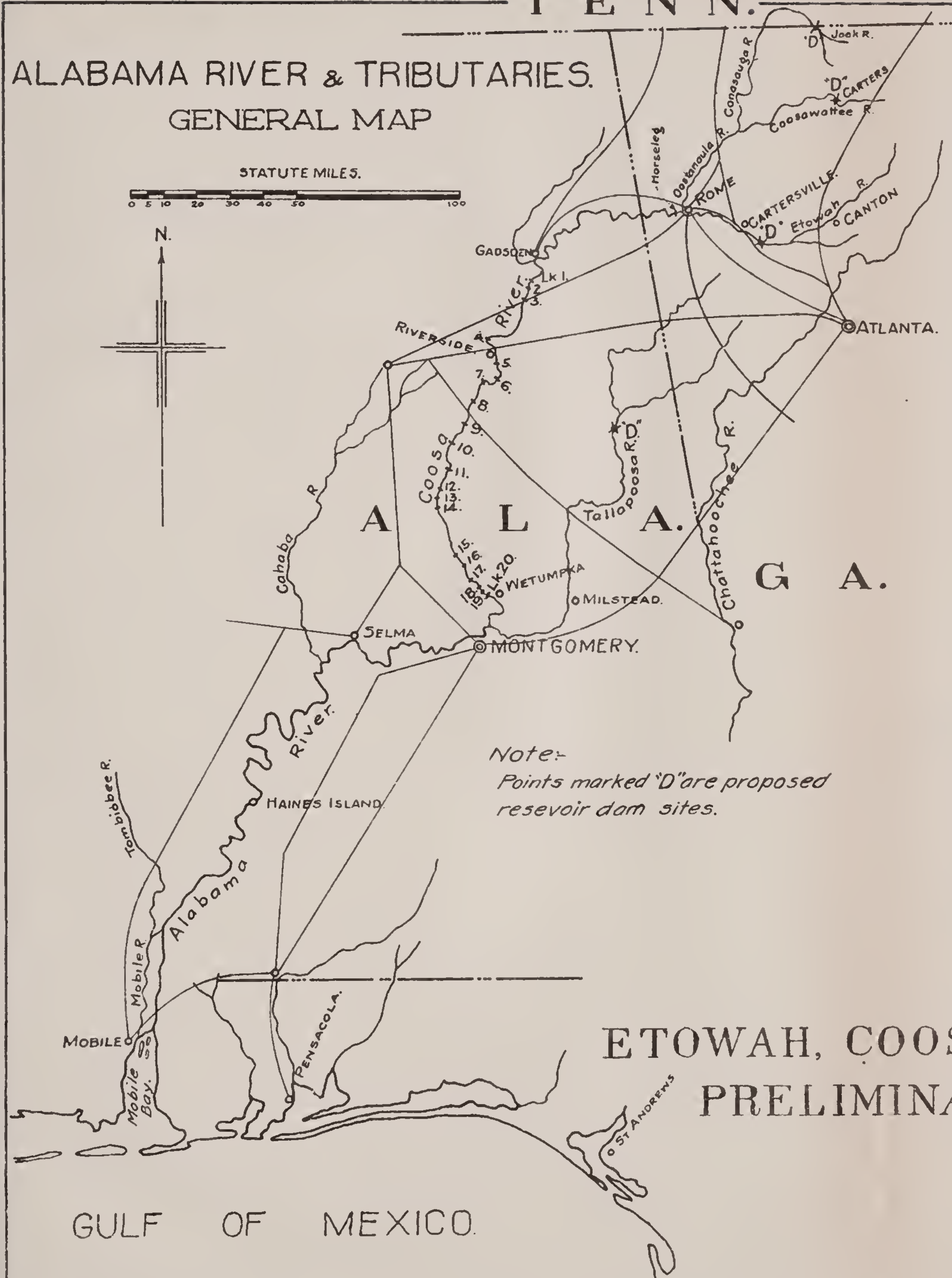


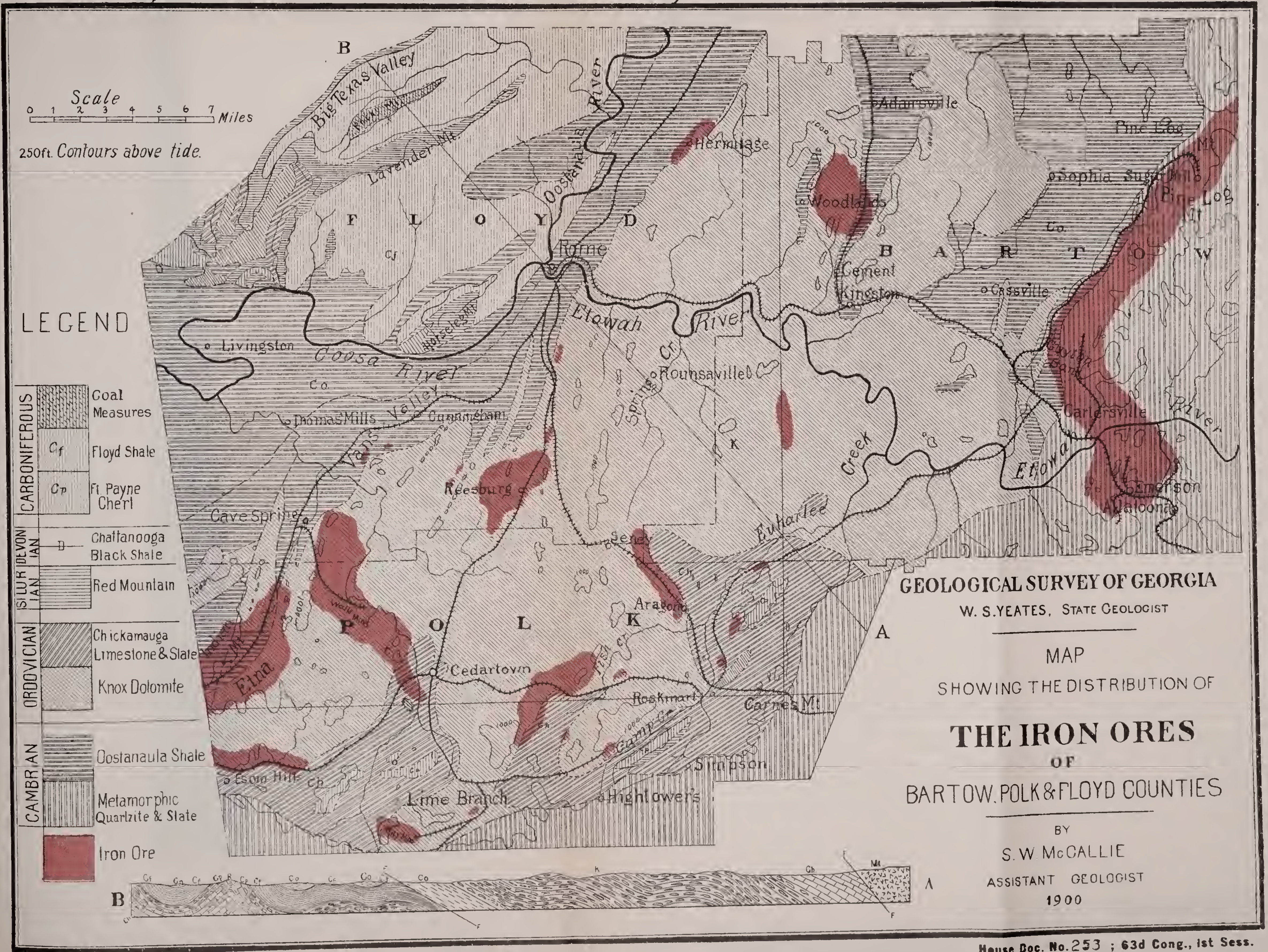
TABLE OF DISTANCES & ELEVATIONS.

Station.	MILES via river from MOBILE.	ELEVATIONS above Sea Level.
Canton, Ga.	744	860.00
Cartersville, Ga.	713	681.50
Rome, Ga.	667	562.00
Horseleg Lk. (proposed upper pool.)	662	565.00
" " " lower "	662	554.00
Gadsden, Ala.	533	486.59
Lock 1 Upper pool.	510	483.30
" 2. " "	507	477.97
" 3. " "	506	472.40
" 4. " "	485	454.30
Riverside, Ala.	481	444.30
Lock 5. (proposed upper pool.)	474	444.30
" 6. " " "	465	437.00
" 7. " " "	461	421.00
" 8. " " "	457	408.00
" 9. " " "	449	400.00
" 10. " " "	425	389.00
" 11. " " "	414	372.00
" 12. " " "	409	350.00
" 13. " " "	405	314.00
" 14. " " "	400	278.00
" 15. " " "	388	251.00
" 16. " " "	383	216.00
" 17. " " "	380	193.00
" 18. " " "	376	172.00
" 19. " " "	371	152.00
" 20. " " "	369	130.00
Wetumpka, Ala.	369	114.67
Montgomery, Ala.	340	100.15
Selma, Ala.	258	59.50
Haines Island.	137	40.35
Mobile, Ala.	0	0.00

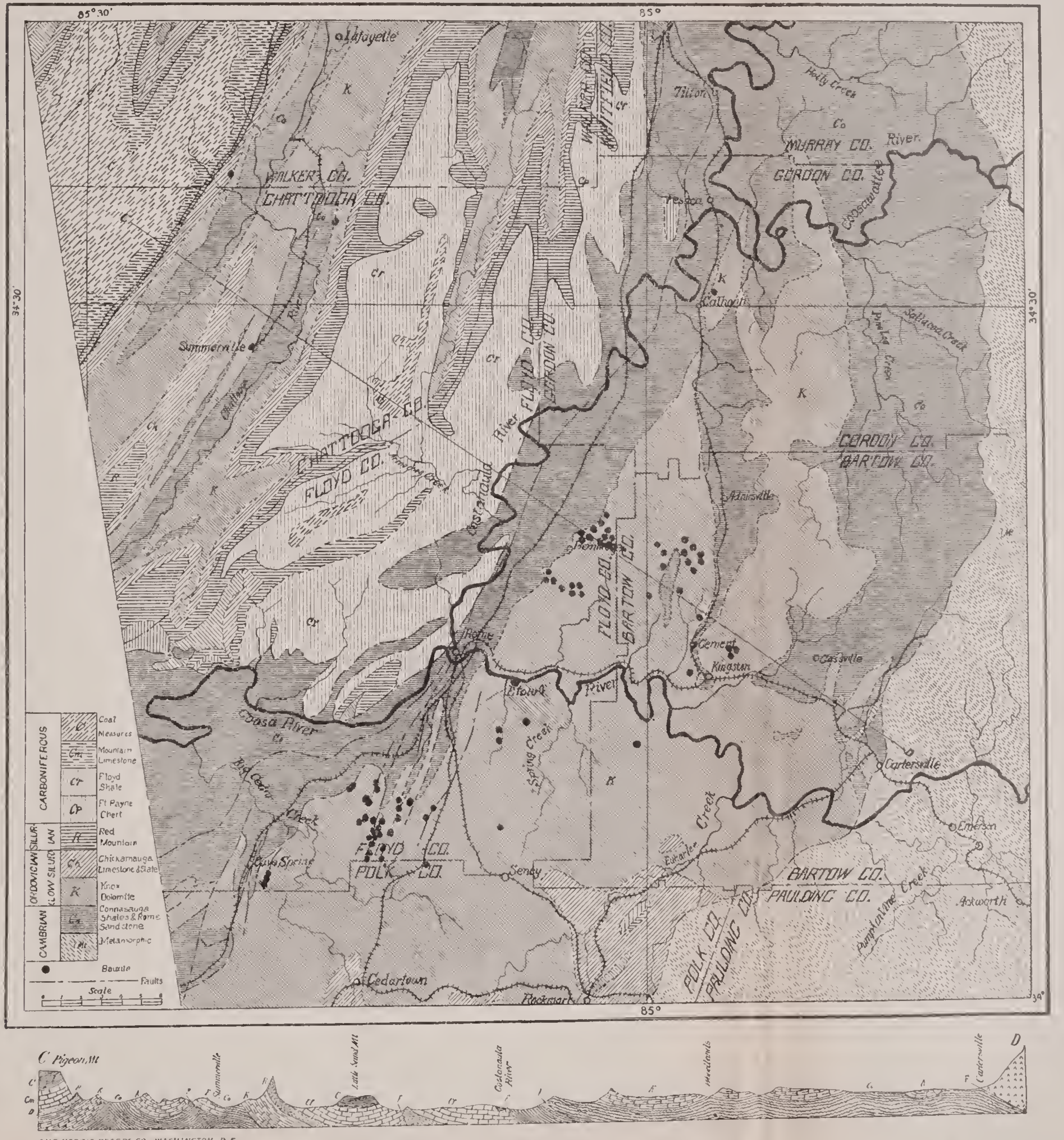
ETOWAH, COOSA, & TALLAPOOSA RIVERS.
PRELIMINARY EXAMINATION 1909.

U. S. Engineer Office,
Montgomery, Ala. June 1st 1909
To accompany report of this date.
H. B. Ferguson
Capt. Corps of Engr's. U. S. A.

THE NORRIS PETERS CO., WASHINGTON, D. C.

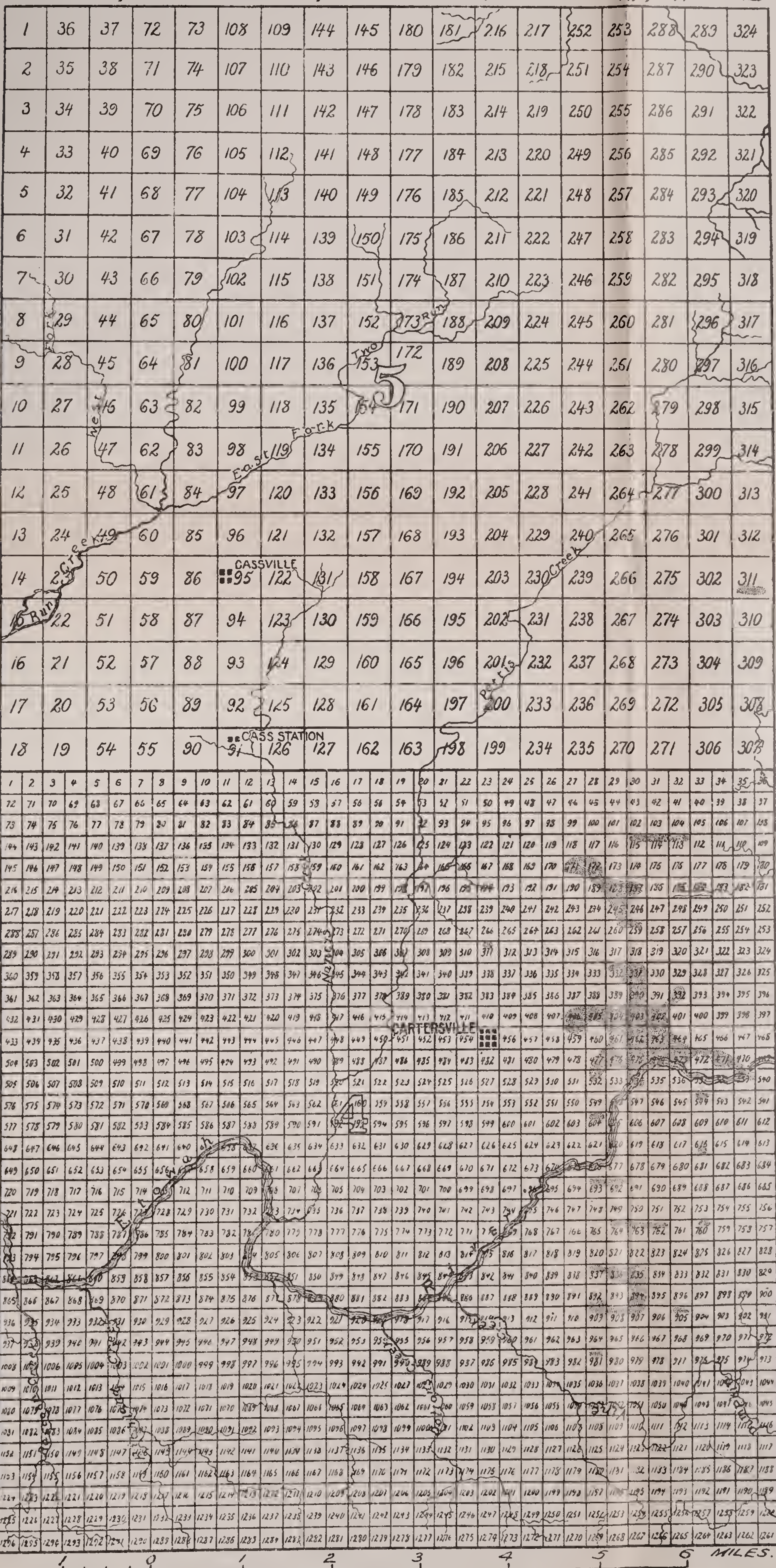

GEOLOGICAL SURVEY OF GEORGIA
W. S. YEATES, State Geologist
MAP
SHOWING THE DISTRIBUTION OF
THE IRON ORES
OF
BARTOW, POLK & FLOYD COUNTIES
BY
S. W. McCALLIE
ASSISTANT GEOLOGIST
1900
Scale
0 1 2 3 4 5 6 7 Miles
250ft. Contours above tide.
LEGEND
CARBONIFEROUS
Coal Measures
Floyd Shale
Ft Payne Chert
DEVONIAN
Chattanooga Black Shale
SILURIAN
Red Mountain
ORDOVICIAN
Chickamauga Limestone & Slate
Knox Dolomite
CAMBRIAN
Oostanaula Shale
Metamorphic Quartzite & Slate
Iron Ore
F L O Y D
B A R T O W
P O L K
Rome
Livingston
Coosa River
Etowah River
Oostanaula River
Big Texas Valley
Lavender Mt
Hermitage
Adairsville
Woodlands
Pine Log
Sophia
Pine Log Mt
Cement
Kingston
Cassville
Cartersville
Emerson
Allatoona
Rounsaville
Spring Cr
Cunningham
Thomas Mills
Vans Valley
Reesburg
Cave Spring
Euharlee Creek
Seney
Aragon
Cedartown
Etna
Rockmart
Carnes Mt
Simpson
Lime Branch
Hightowers
Esom Hill
A
B

Bauxite in Georgia, Etowa, Coosa and Tallapoosa Rivers, Preliminary Examination, Report of June 1, 1909.-MAP NO. 6.



Map Showing the Distribution of the Bauxite Deposits of Georgia

Ocher in Georgia; Etowa, Coosa and Tallapoosa Rivers. MAP NO. 8.
Preliminary Examination Report of June 1, 1909. Appendix "B"



Lot Map of the 4th and 5th Districts of Bartow County, Georgia, Showing the Ocher Areas Shaded.

THE NORRIS PETERS CO. WASHINGTON, D. C.

MAP NO. 9

ETOWAH, COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909

MAP OF RESERVOIR SITE No. 1
TALLAPOOSA RIVER AT CHEROKEE BLUFFS, ALA.

FROM SURVEY MADE OCT. 16, 1909 TO JAN. 12, 1910
UNDER THE DIRECTION OF
CAPTAIN H. B. FERGUSON,
CORPS OF ENGINEERS, U. S. A.
BY
D. M. ANDREWS, ASSISTANT ENG'R. O. E. YOUNG, JUNIOR ENG'R. CHIEF OF PARTY.

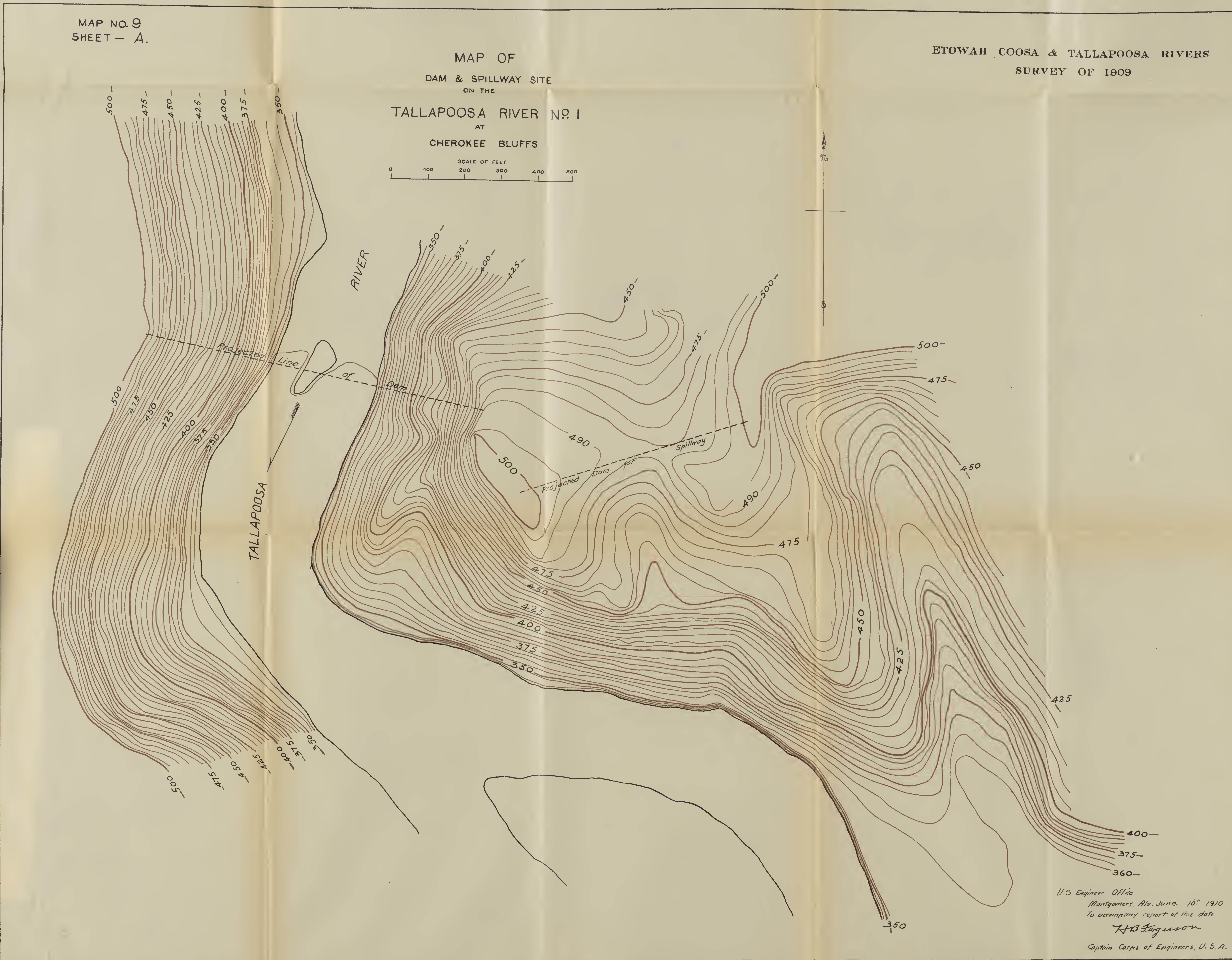
SCALE—FEET
1000 0 5000 13000

SCALE—MILES
0 ¼ ½ ¾ 1 2 3

CONTOUR INTERVALS, 20 FEET UP TO 480, ABOVE 480, 10 FEET. ELEVATIONS REFER TO MEAN SEA LEVEL

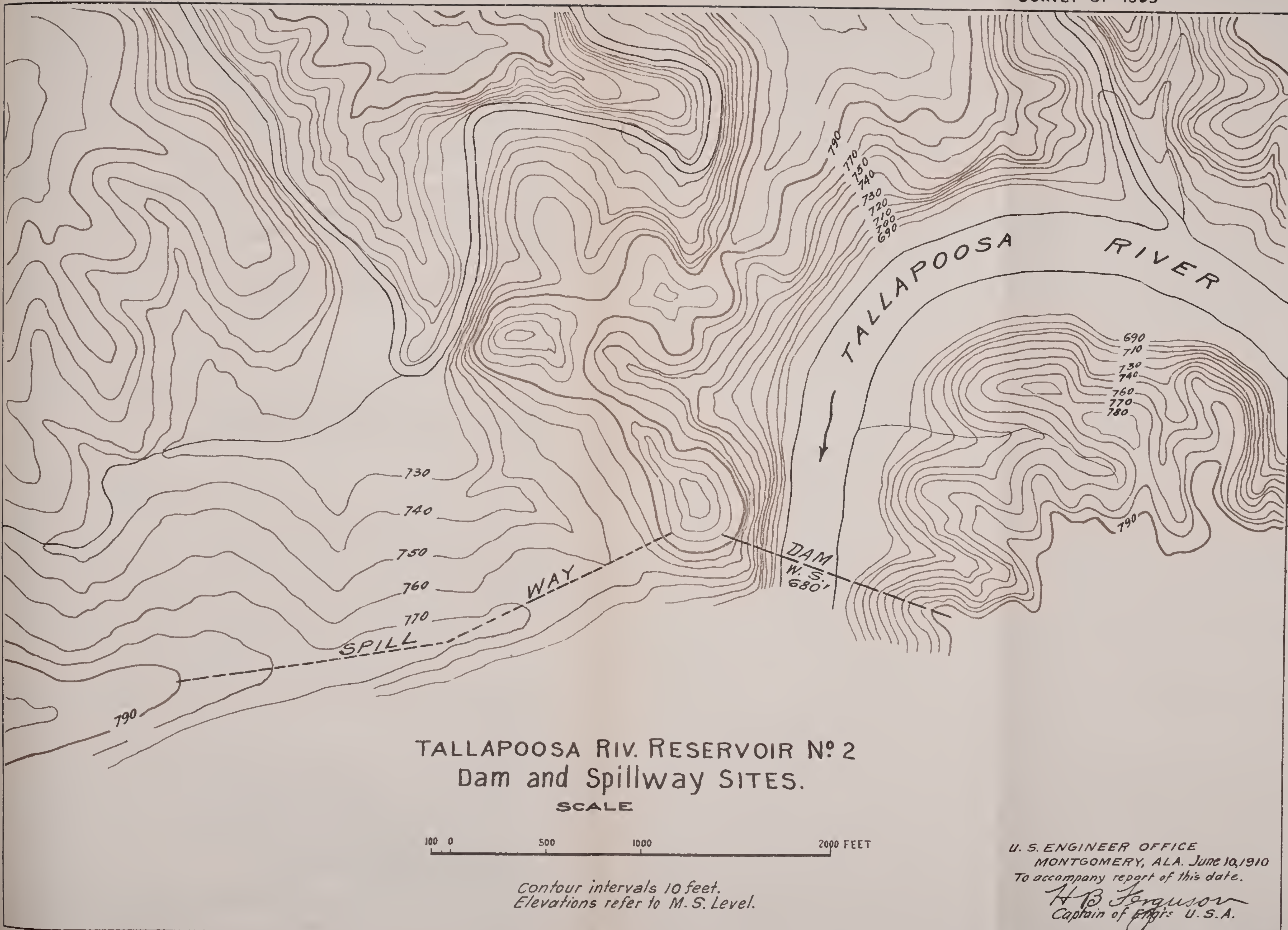
U. S. ENGINEER OFFICE,
MONTGOMERY, ALA.
To accompany report of June 10, 1910.
H B Ferguson
Captain Corps of Ingineers, U. S. A.

House Doc. No. 253; 63d Cong., 1st Sess.

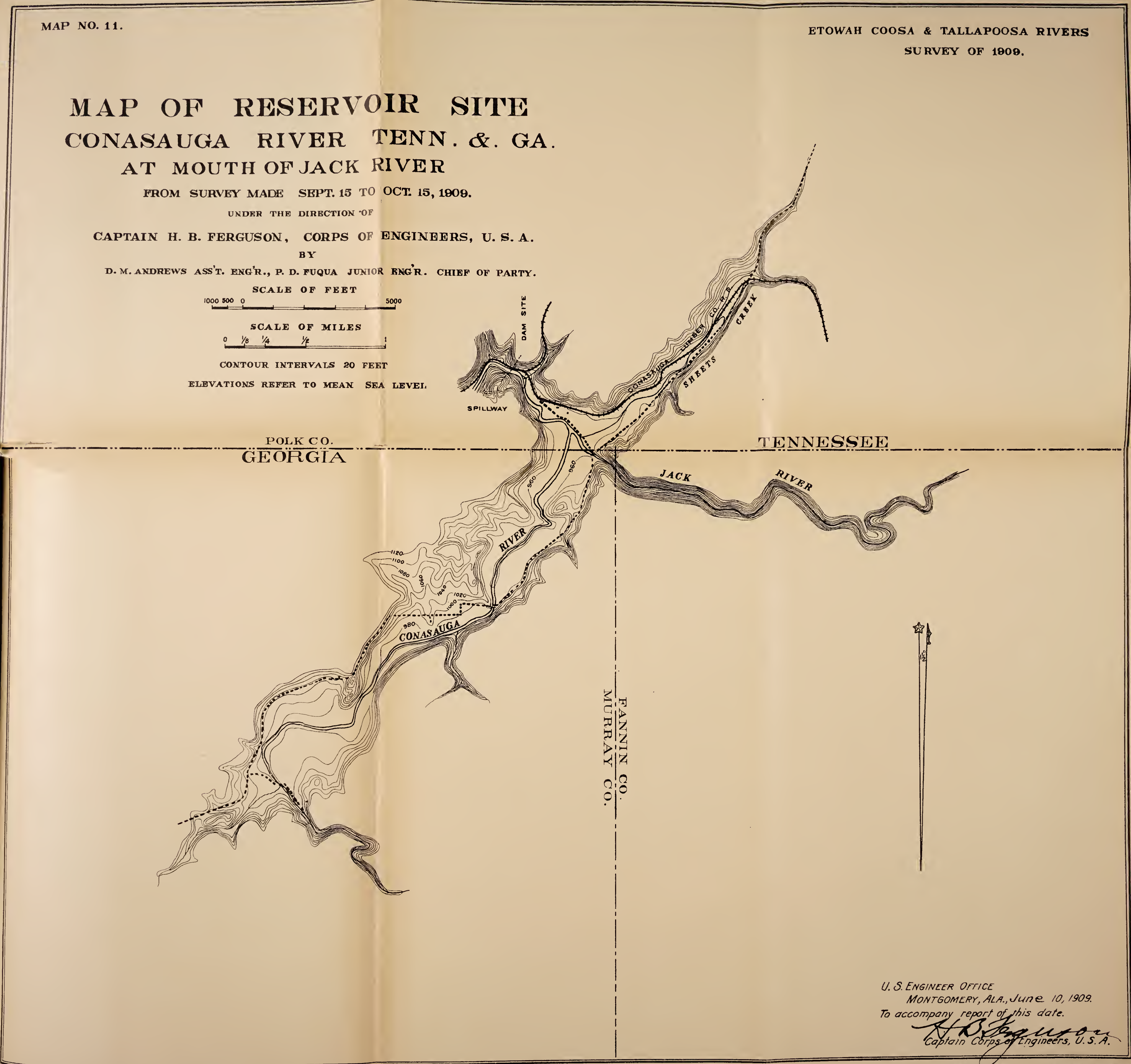


House Doc. No. 253; 63d Cong., 1st Sess.

House Doc. No. 253 ; 63d Cong., 1st Sess.



THE NORRIS PETERS CO., WASHINGTON, D. C.

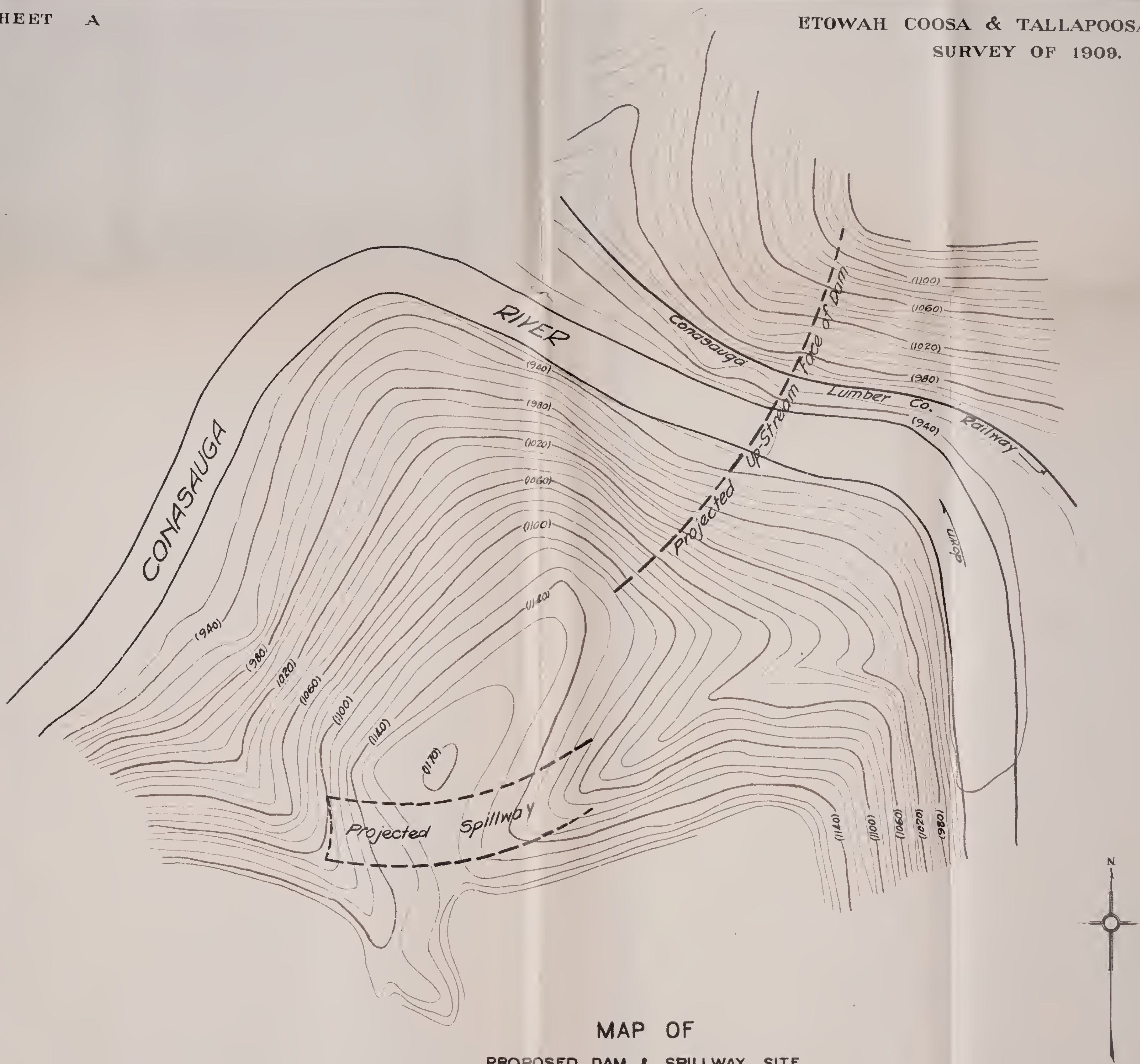


THE NORRIS PETERS CO., WASHINGTON, D. C.

House Doc. No. 253 ; 63d Cong., 1st Sess.

MAP NO. 11
SHEET A

ETOWAH COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909.



MAP OF

PROPOSED DAM & SPILLWAY SITE

ON THE

CONASAUGA RIVER

SCALE OF FEET

0 100 200 300 400 500

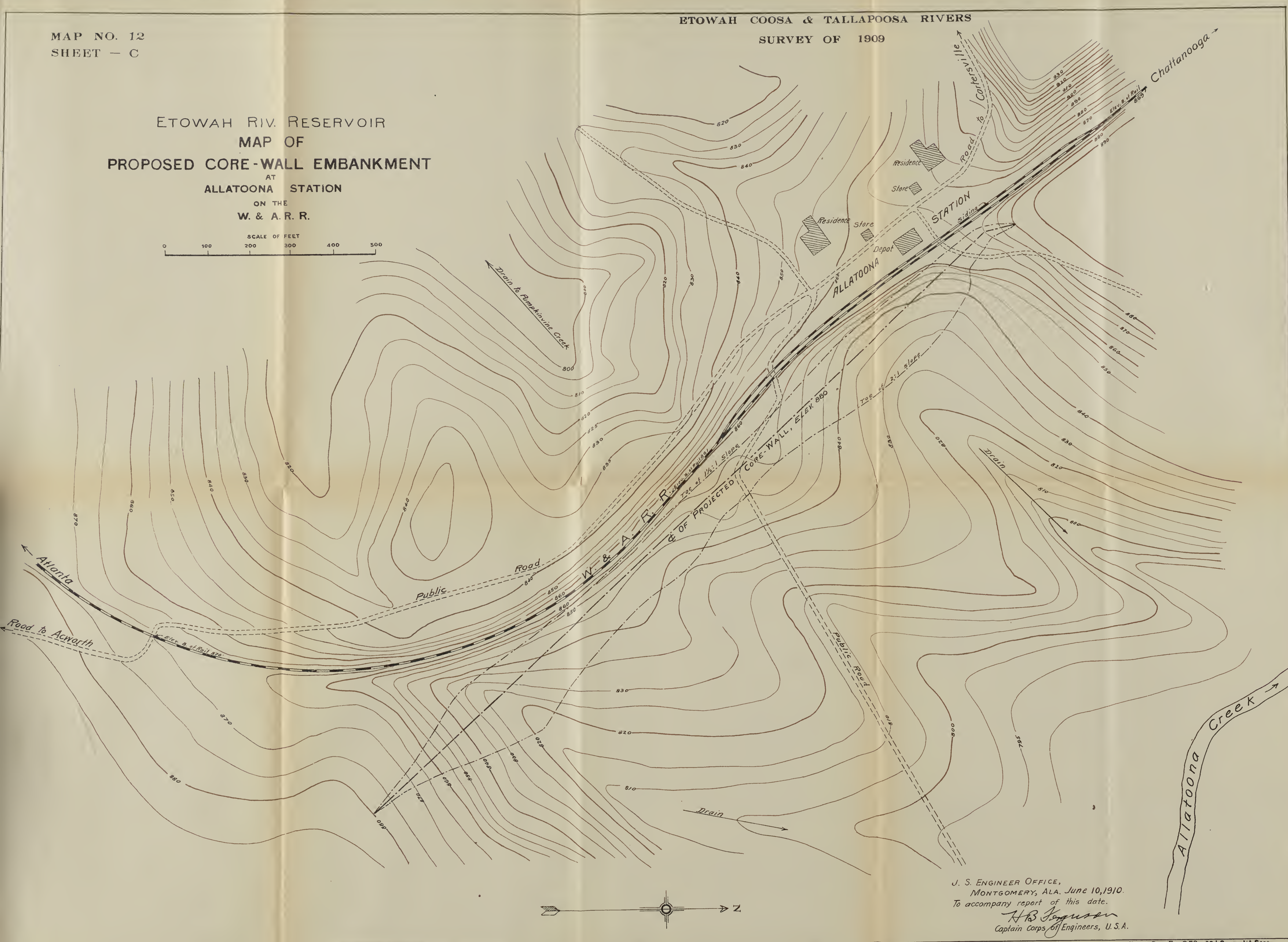
U. S. ENGINEER OFFICE
MONTGOMERY, ALA., June 10, 1910.
To accompany report of this date
H B Ferguson
Captain Corps of Engineers, U.S.A.

THE NORRIS PETERS CO. WASHINGTON, D. C.

House Doc. No. 253 ; 63d Cong., 1st Sess.

THE NORRIS PETERS CO., WASHINGTON, D.C.

House Doc. No. 253 ; 63d Cong., 1st Sess.



MAP NO. 12
SHEET — C
ETOWAH COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909
ETOWAH RIV. RESERVOIR
MAP OF
PROPOSED CORE-WALL EMBANKMENT
AT
ALLATOONA STATION
ON THE
W. & A.R.R.
SCALE OF FEET
0 100 200 300 400 500
Drain to Pumpkinvine Creek
Road to Cartersville
Chattanooga
Residence
Store
Residence
Store
Depot
ALLATOONA
STATION
Siding
W. & A. R. R.
Toe of 1½:1 Slope
℄ OF PROJECTED CORE-WALL, ELEV. 880
Toe of 2:1 Slope
Drain
Public Road
Public Road
Atlanta
Road to Acworth
Elev. B. of Rail 870
Drain
Allatoona Creek
J. S. ENGINEER OFFICE,
MONTGOMERY, ALA. June 10, 1910.
To accompany report of this date.
H B Ferguson
Captain Corps of Engineers, U.S.A.

THE NORRIS PETERS CO., WASHINGTON, D. C.

MAP NO. 12
SHEET — E

ETOWAH COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909.

ETOWAH RIVER RESERVOIR.

PROSED REVISION OF W. & A. R.R.

Near Allatoona, Ga.

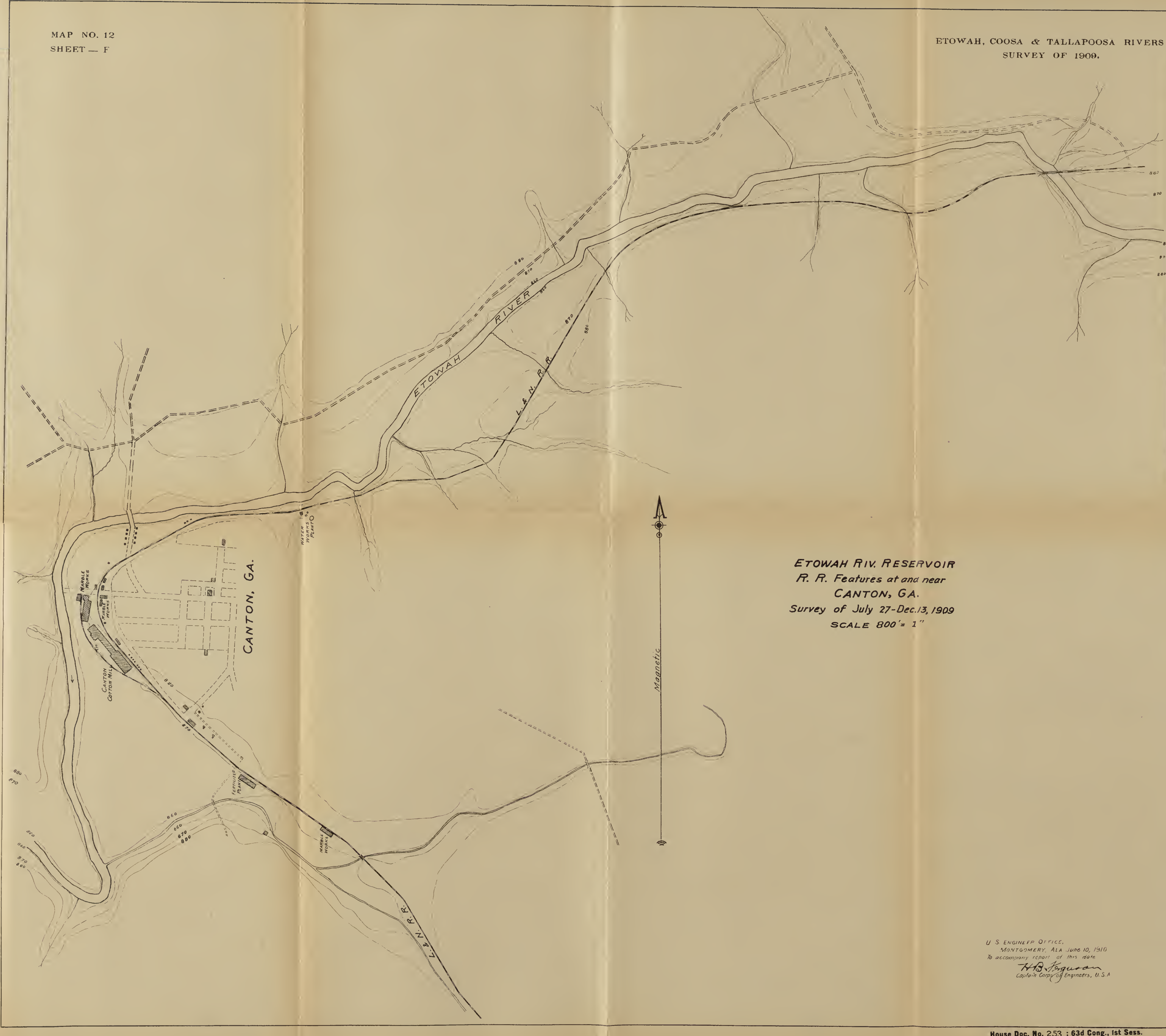
— ESTIMATE —

5 Acres Clearing & Grubbing	@ $50.00	$250.00
24 540 Cu. Yds S. R. Excav.	, .75	18 405.00
24 540 „ „ L. R. „	, .40	9 816.00
57 500 „ „ Earth „	, .25	14 375.00
12 700 „ „ „ Borrow	, .25	3 175.00
290 000 „ „ Stas. Overhaul	, .01¼	3625.00
58 Lin. Ft. 24" C.I.P. in place	, 3.00	174.00
5 000 Cu. Yds. Ballast in place	, 1.00	5 000.00
4 100 Cross Ties, deliv.	, .60	2460.00
222 Tons 90# Rails	, 35.00	7770.00
Spikes & Rail Joints		800.00
Hauling Material to place		500.00
1.55 M. Track Laying	@ 600.00	930.00
Moving Allatoona Depot		300.00
Road Crossings. Etc.		500.00
Land Damage		2 500.00
100 Cu. Yds. Concrete Culvert Headwalls	@ 8.00	800.00
Engineering & Contingencies, 10%		7138.00
Total Cost.		$ 78 518.00

— COMPARISON WITH PRESENT TRACK. —

	Present Track	Proposed Change.
Vertical Lift	40.00	16.00
Length	7735.00	8115.00
Curvature	257° 00'	254° 40'
Max. Curve	5° 30'	5° 00'
Max. Grade	0.67%	0.45%

U. S. ENGINEER OFFICE
MONTGOMERY, ALA JUNE 10, 1910
To accompany report of this date
H B Ferguson
Captain Corps of Engineers, U. S. A.

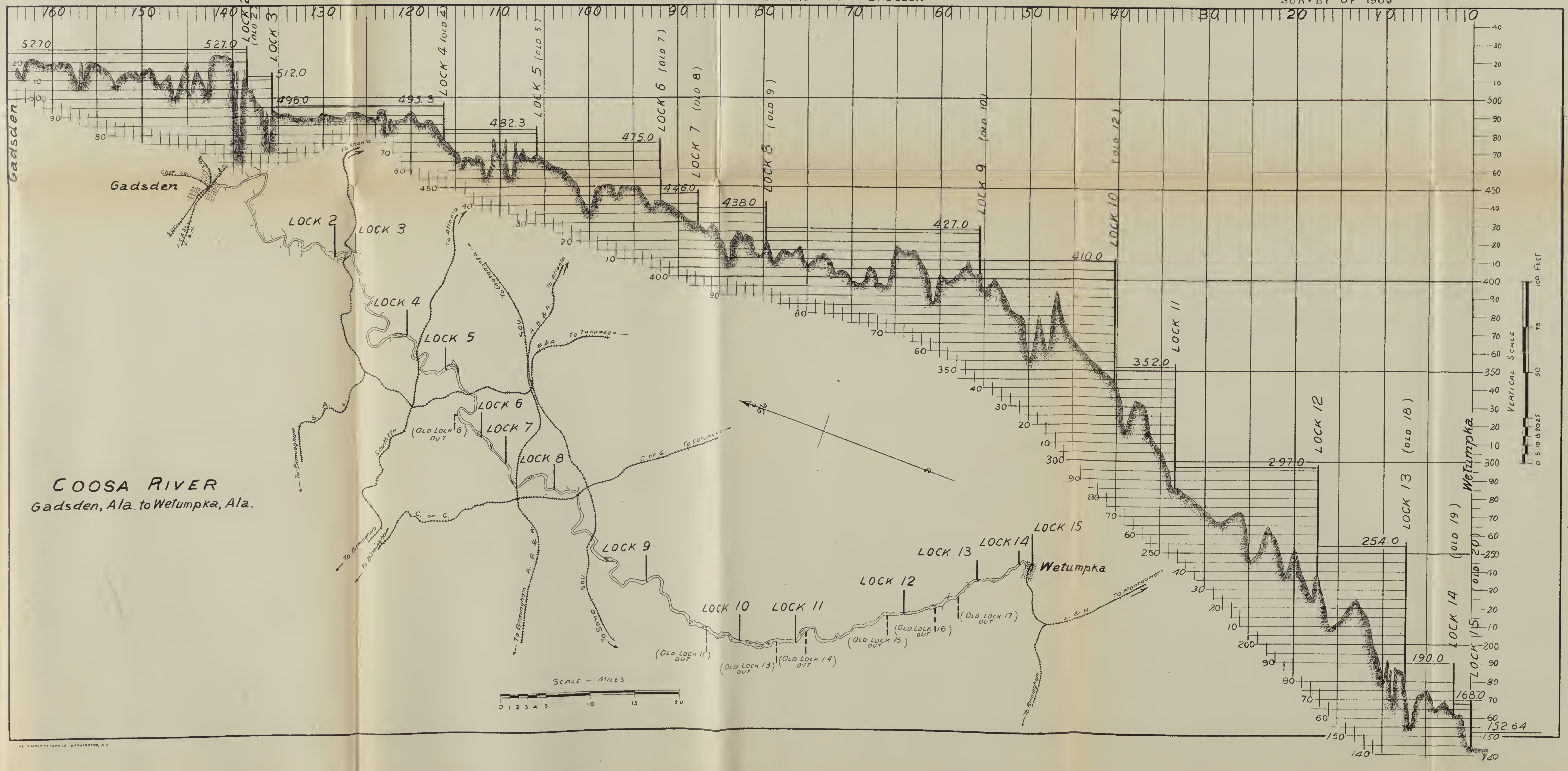


House Doc. No. 253 ; 63d Cong., 1st Sess.

THE NORRIS PETERS CO., WASHINGTON, D. C.

MAP NO. 13

ETOWAH, COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909



NAVIGATION						POWER			
Dam	Feet Lift	Low Water Feet		High Water Feet		Effective Power Head	Pondage & Storage Feet		
Nº	L W	Upper Pool	Lower Pool	Upper Pool	Lower Pool	Feet	Total	Pondage	Storage
2	15	527.00	512.00	535.00	518.50	26	8.0	0.33	7.67
3	16	512.00	496.00						
4	13	495.30	482.30	509.50	504.00				
5	7.3	482.30	475.00	493.00	490.00				
6	29	475.00	446.00	485.00	464.00	29			
7	8	446.00	438.00	459.00	456.00				
8	11	438.00	427.00	452.50	440.00				
9	17	427.00	410.00	435.00	425.00				
10	58	410.00	352.00	420.50	366.00	63	10.0	0.41	9.59
11	55	352.00	297.00	362.50	318.50	50			
12	43	297.00	254.00	310.00	270.00	42	5.0	0.84	4.16
13	64	254.00	190.00	267.00	209.00	63	6.0	0.80	5.20
14	22	190.00	168.00	203.50	199.00				
15	15.33	168.00	152.67	196.00	195.50				

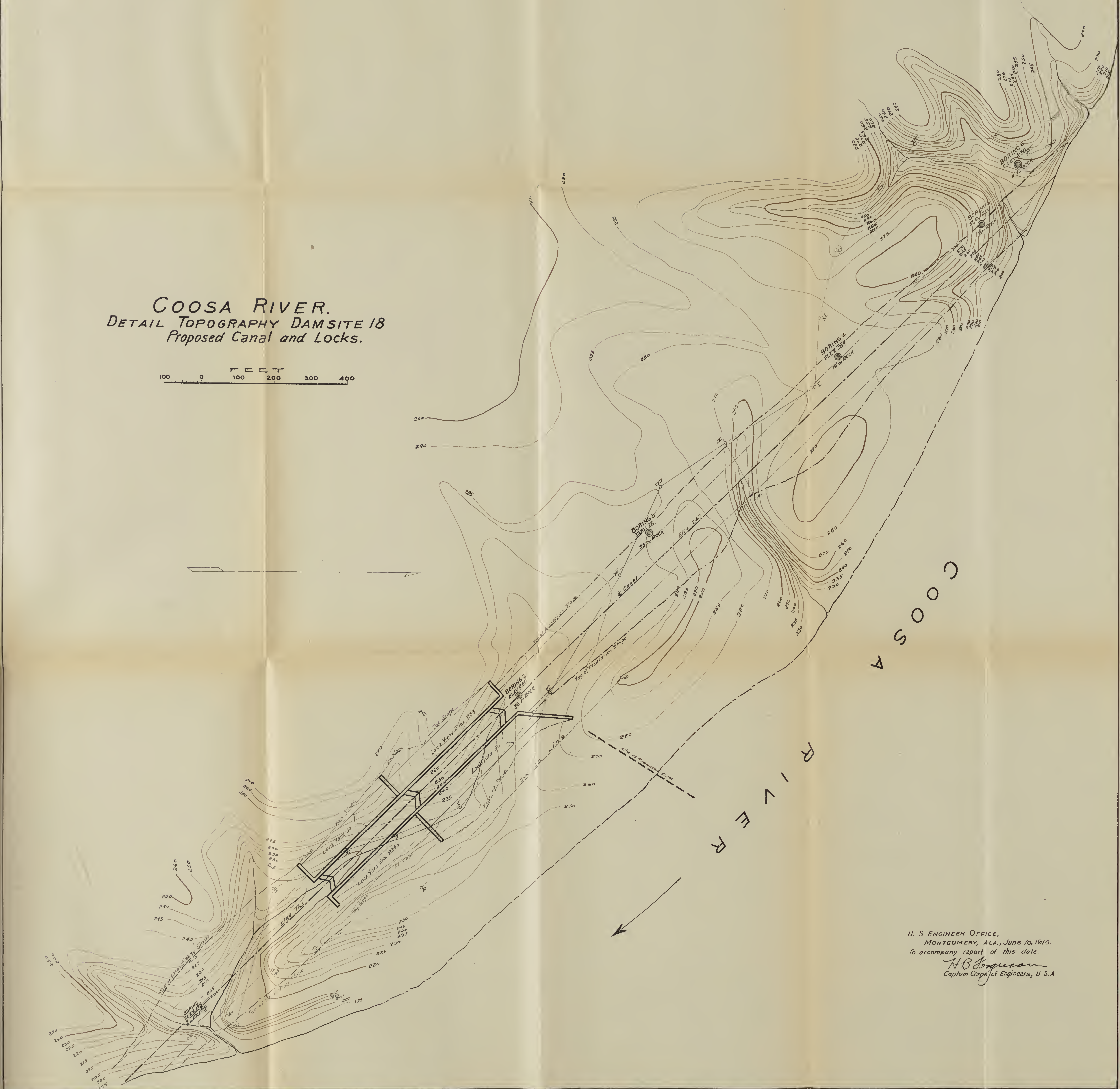
Note

A flight of two Locks each is provided at Dams 10, 11, 12 & 13

The old numbers of the report of 1905 are given in brackets ( )

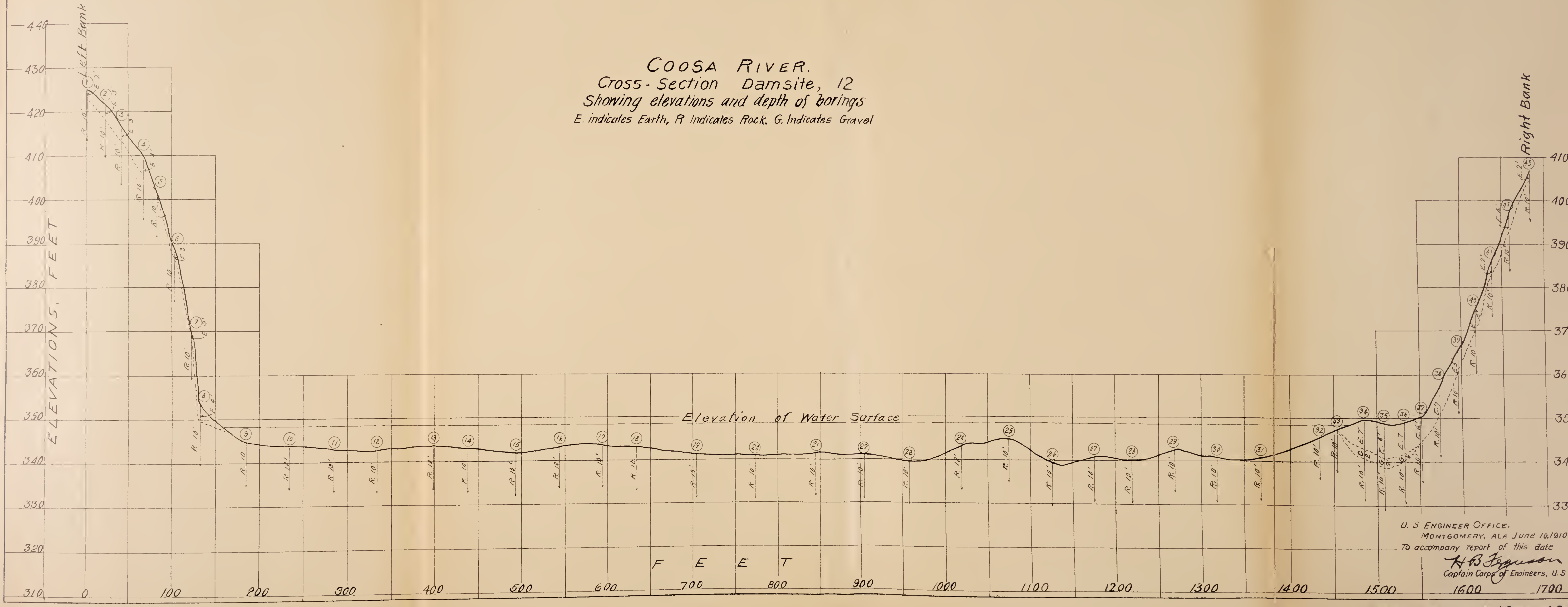
U.S. ENGINEER OFFICE
MONTGOMERY ALA JUNE 10, 1910
to accompany report of this date
H B Ferguson
Captain Corps of Engineers U.S.A.

House Doc. No. 253 ; 63d Cong., 1st Sess.

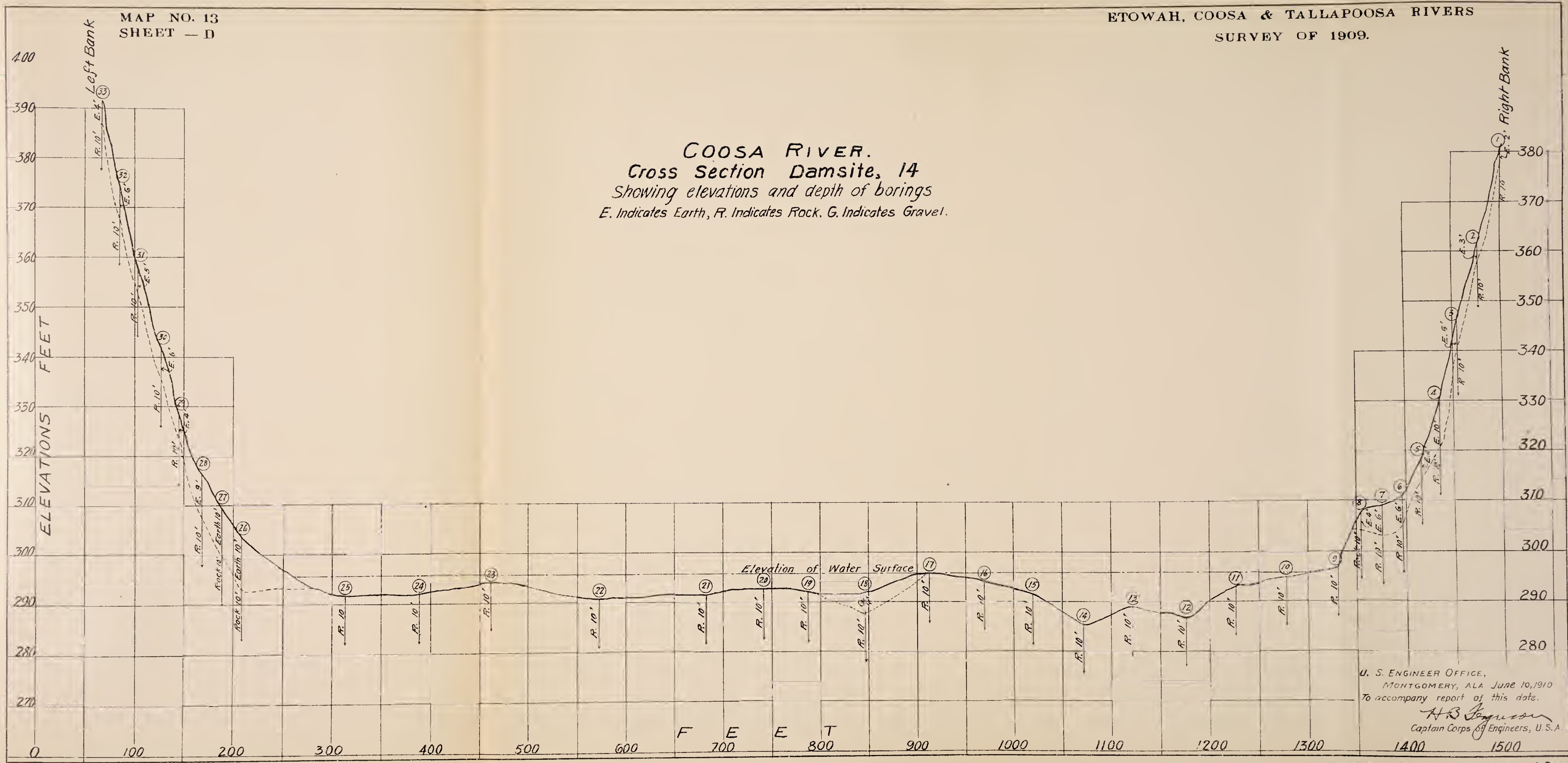

COOSA RIVER.
DETAIL TOPOGRAPHY DAMSITE 18
Proposed Canal and Locks.
FEET
100 0 100 200 300 400
COOSA RIVER
BORING 2
BORING 3
BORING 4
BORING 6
Line of Proposed Dam
U. S. ENGINEER OFFICE,
MONTGOMERY, ALA., June 10, 1910.
To accompany report of this date.
H B Ferguson
Captain Corps of Engineers, U.S.A.

MAP NO. 13
SHEET — C

ETOWAH. COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909.



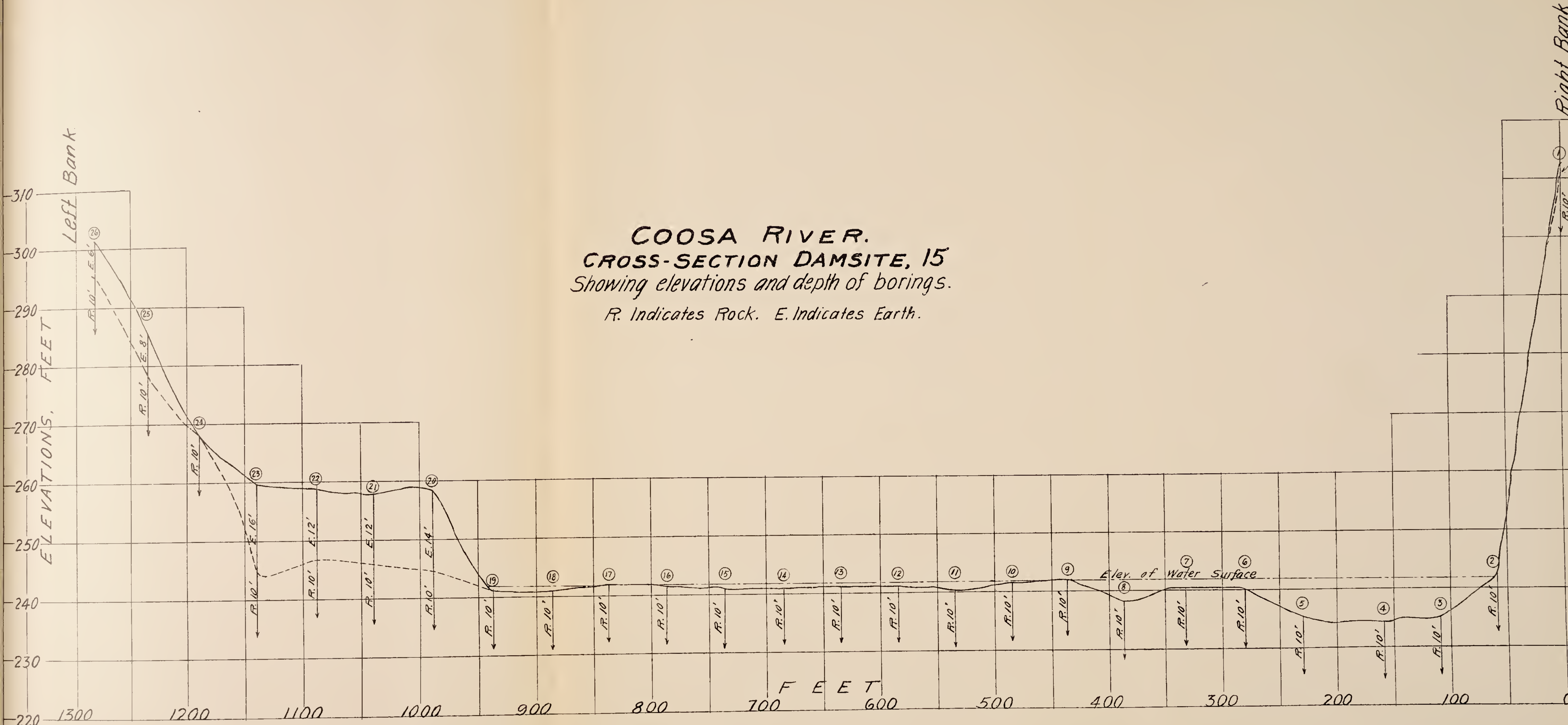
THE NORRIS PETERS CO., WASHINGTON, D.C.


MAP NO. 13
SHEET — D
ETOWAH, COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909.
COOSA RIVER.
Cross Section Damsite, 14
Showing elevations and depth of borings
E. Indicates Earth, R. Indicates Rock. G. Indicates Gravel.
Left Bank
Right Bank
ELEVATIONS FEET
Elevation of Water Surface
F E E T
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
400
390
380
370
360
350
340
330
320
310
300
290
280
270
U. S. ENGINEER OFFICE,
MONTGOMERY, ALA June 10, 1910
To accompany report of this date.
H. B. Ferguson
Captain Corps of Engineers, U.S.A.

MAP NO. 13
SHEET — E

ETOWAH, COOSA & TALLAPOOSA RIVE

SURVEY OF 1909



U. S. ENGINEER OFFICE,
MONTGOMERY, ALA. June
To accompany report of this
H B Fergu

TABLE 1

TABLE OF ANNUAL RAINFALL RUN-OFF AND SLOPE, ALABAMA & COOSA RIVER WATERSHED ABOVE SELMA ALA.

Including Discharge and Gage Heights at Selma.

*Note – Figures with * are interpolated, no rainfall being recorded.*

U. S. Engineer Office,
Montgomery, Ala. June 1st 1909
To accompany report of this date.
H B Ferguson
Capt. Corps of Engr's. U. S. A.

Average Slope of Watershed (X) Feet per Mile (Not determined on account of insufficient data.)

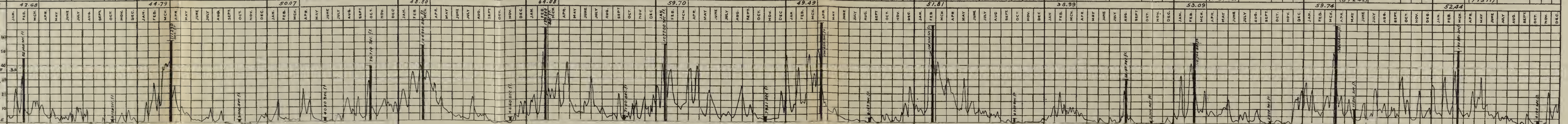
Station	Area Sq. Miles	1896 Annual Rainfall Inches	1896 Rainfall Inch Miles ()=Cu.Ft.Miles	1896 Mean Discharge Sec. Feet	1896 Runoff: Rainfall, feet per Sq. Mile	1896 Runoff: Runoff, feet per Sq. Mile	1896 Runoff: Percentage of Loss	1897 Annual Rainfall Inches	1897 Rainfall Inch Miles ()=Cu.Ft.Miles	1897 Mean Discharge Sec. Feet	1897 Runoff: Rainfall, feet per Sq. Mile	1897 Runoff: Runoff, feet per Sq. Mile	1897 Runoff: Percentage of Loss	1898 Annual Rainfall Inches	1898 Rainfall Inch Miles ()=Cu.Ft.Miles	1898 Mean Discharge Sec. Feet	1898 Runoff: Rainfall, feet per Sq. Mile	1898 Runoff: Runoff, feet per Sq. Mile	1898 Runoff: Percentage of Loss
Cleveland, Tenn.	328	40.78	13376					49.76	16321					46.15	15137				
Dahlonega, Ga.	85	49.02	4167					55.76	4740					71.77	6109				
Diamond, Ga.	433	50.36	21806					59.91	25941					67.52	29236				
Gainsville, Ga.	72	57.60*	4147*					50.32	3623					58.65	4223				
Alpharetta, Ga.	150	47.36*	7104*					45.34*	6801*					53.75*	8063*				
Canton, Ga.	680	50.36*	34248*					46.44	31579					51.54	35047				
Adairville, Ga.	400	35.92	14368					46.72	18688					56.41	22564				
Atlanta, Ga.	113	34.12	3856					39.26	4436					51.06	5770				
Tallapoosa, Ga.	1305	49.80*	64989*					41.06	53583					58.87	76825				
Rome, Ga.	669	39.54	26452					48.08	32166					52.48	35109				
Ramsey, Ga.	571	37.53	21430					52.45	29949					52.49	29972				
Resaca, Ga.	257	37.00*	9509*					50.00*	12850*					53.00*	13621*				
Greenbush, Ga.	505	40.00*	20200*					52.00*	26260*					65.08	32865				
Valleyhead, Ala.	250	43.52	10880					54.50	13625					58.00*	13000*				
Maple Grove, Ala.	758	35.00*	26530*					46.00*	34868*					50.00	37900*				
Gadsden, Ala.	397	36.00*	14292*					44.01	17572					48.56	19268				
Ashville, Ala.	290	34.67	10054					42.15	12223					46.14	13381				
Anniston, Ala.	676	34.56	23363					42.06	28433					46.00*	31096*				
Lock 4, Ala.	405	37.99	15386					42.45	17192					46.47	18820				
Talladega, Ala.	737	36.00*	26532*					39.14	28846					50.21	37005				
Birmingham, Ala.	264	36.99	9765					47.73	12601					46.59	12300				
Goodwater, Ala.	1212	39.76	48189					40.00*	48480*					43.83	53122				
Clanton, Ala.	1142	48.05	58473					25.92	29601					42.00*	47964*				
Wetumpka, Ala	425	49.57	21067					47.58	20222					48.58	20647				
Newnan, Ga.	160	50.00*	8000*					45.44	7210					49.00	7840*				
Rockmills, Ala.	624	43.00*	26832*					51.21	31955					53.00*	33072*				
Opelika, Ala.	500	34.03	17015					44.79	22395					58.68	2934[illegible]				
Tallassee, Ala.	820	42.00*	34440*					46.52	38146					46.00*	37720*				
Union Springs, Ala.	520	60.31	31361					53.82	27986					51.07	26556				
Montgomery, Ala.	687	45.82	31478					46.25	31774					39.75	27308				
Fort Deposit, Ala.	393	46.31	18200					46.00*	18078*					42.00*	16506*				
Selma, Ala.	490	38.61	18919	17623			70%	46.15	22614	23171			62%	40.24	19718	20724			69%
Totals	16318	1361.55	696425 (58035)	17623	3.55	1.08	2.47	1488.82	730918 (60910)	23171	3.75	1.42	2.31	1638.99	817104 (68092)	20724	4.17	1.27	2.90
Average		42.68						44.79						50.07					

Station	1899 Annual Rainfall Inches	1899 Rainfall Inch Miles ()=Cu.Ft.Miles	1899 Mean Discharge Sec. Feet	1899 Runoff: Rainfall, feet per Sq. Mile	1899 Runoff: Runoff, feet per Sq. Mile	1899 Runoff: Percentage of Loss	1900 Annual Rainfall Inches	1900 Rainfall Inch Miles ()=Cu.Ft.Miles	1900 Mean Discharge Sec. Feet	1900 Runoff: Rainfall, feet per Sq. Mile	1900 Runoff: Runoff, feet per Sq. Mile	1900 Runoff: Percentage of Loss	1901 Annual Rainfall Inches	1901 Rainfall Inch Miles ()=Cu.Ft.Miles	1901 Mean Discharge Sec. Feet	1901 Runoff: Rainfall, feet per Sq. Mile	1901 Runoff: Runoff, feet per Sq. Mile	1901 Runoff: Percentage of Loss
Cleveland, Tenn.	50.67*	16620*					56.17	18424					65.75	21566				
Dahlonega, Ga.	54.78	4656					72.12	6130					73.18	6220				
Diamond, Ga.	59.12	25599					72.72	1488					78.90	34164				
Gainsville, Ga.	48.01	3457					57.60*	4147*					68.78	4952				
Alpharetta, Ga.	46.93*	7040*					55.60*	8340*					63.61*	9542*				
Canton, Ga.	50.36*	34245*					50.36*	34245*					62.28	42350				
Adairville, Ga.	47.88	19152					62.43	24972					61.56	24624				
Atlanta, Ga.	42.42	4793					58.83	6648					59.77	6754				
Tallapoosa, Ga.	49.80*	64989*					49.80*	64989*					49.80*	64989*				
Rome, Ga.	49.42	33062					65.28	43672					67.31	45030				
Ramsey, Ga.	50.20	28664					59.74	34112					64.62	36898				
Resaca, Ga.	49.00*	12593*					61.00*	15677*					60.56	15564				
Greenbush, Ga.	58.53	29558					68.07	34375					69.00*	34845*				
Valleyhead, Ala.	60.35	15088					74.45	18613					73.82	18455				
Maple Grove, Ala.	56.53	42850					69.45	52643					70.00	53060				
Gadsden, Ala.	52.66	20906					65.18	25876					62.99	25007				
Ashville, Ala.	53.23	15437					71.08	20613					64.98	18854				
Anniston, Ala.	45.91	31035					65.82	44494					57.67	38985				
Lock 4, Ala.	47.11	19080					71.39	28913					63.49	25713				
Talladega, Ala.	46.02	33917					68.00*	50116*					56.04	41301				
Birmingham, Ala.	48.48	12799					76.21	20119					61.59	16260				
Goodwater, Ala.	46.00*	55752*					75.48	91482					60.09	72829				
Clanton, Ala.	42.00*	47964*					68.00*	77656*					50.29	57431				
Wetumpka, Ala	45.07	19155					66.54	28280					47.22	20069				
Newnan, Ga.	43.03	6885					62.47	99.95					63.38	10207				
Rockmills, Ala.	48.00*	29952*					70.00*	43680*					61.00*	38064*				
Opelika, Ala.	45.28	22640					73.07	36535					67.38	33690				
Tallassee, Ala.	44.64	36605					55.00*	45100*					55.91	45846				
Union Springs, Ala.	53.27	27700					65.76	34195					65.61	34117				
Montgomery, Ala.	51.63	35470					59.92	41165					52.24	35889				
Fort Deposit, Ala.	47.00*	18471*					54.00*	21222*					48.00*	18864*				
Selma, Ala.	41.17	20173	30351			54%	56.14	27509	36715			58%	44.88	21991	40305			50%
Totals	1574.50	796307 (66365)	30351	4.07	1.86	2.21	2057.68	1045425 (87119)	36715	5.34	2.25	3.09	1971.70	974130 (81177)	40305	4.98	2.47	2.51
Average	48.80						64.08						59.70					

Station	1902 Annual Rainfall Inches	1902 Rainfall Inch Miles ()=Cu.Ft.Miles	1902 Mean Discharge Sec. Feet	1902 Run-off: Rainfall, feet per Sq. Mile	1902 Run-off: Run-off feet per Sq. Mile	1902 Run-off: Percentage of Loss	1903 Annual Rainfall Inches	1903 Rainfall Inch Miles ()=Cu.Ft.Miles	1903 Mean Discharge Sec. Feet	1903 Run-off: Rainfall, feet per Sq. Mile	1903 Run-off: Run-off feet per Sq. Mile	1903 Run-off: Percentage of Loss	1904 Annual Rainfall Inches	1904 Rainfall Inch Miles ()=Cu.Ft.Miles	1904 Mean Discharge Sec. Feet	1904 Run-off: Rainfall, feet per Sq. Mile	1904 Run-off: Run-off feet per Sq. Mile	1904 Run-off: Percentage of Loss
Cleveland, Tenn.	50.67*	16620*					59.53	19525					50.67*	16620*				
Dahlonega, Ga.	47.95	4076					60.62	5153					39.20	3332				
Diamond, Ga.	50.97	22070					63.00	27279					48.80	21130				
Gainsville, Ga.	54.63	3933					59.34	4272					57.60*	4147*				
Alpharetta, Ga.	45.84*	6876*					52.79*	7919*					42.95*	6443*				
Canton, Ga.	38.94	26479					50.36*	34245*					38.13	25928				
Adairville, Ga.	48.50*	19400*					48.50*	19400*					39.98	15982				
Atlanta, Ga.	43.96	4967					48.66	5499					33.13	3744				
Tallapoosa, Ga.	49.80*	64989*					49.80*	64989*					28.54	37245				
Rome, Ga.	46.54	31135					52.16	34895					43.49	29094				
Ramsey, Ga.	45.13	25769					49.06	28013					38.50	21984				
Resaca, Ga.	41.09	10560					49.04	12603					38.57	9912				
Greenbush, Ga.	43.00*	21715*					50.00*	25250*					41.17	20791				
Valleyhead, Ala.	40.60	10150					53.94	13485					43.22	10805				
Maple Grove, Ala.	50.42	38218					52.66	39916					37.74	28607				
Gadsden, Ala.	46.34	18396					51.22	20334					40.78	16190				
Ashville, Ala.	50.61	14677					49.11	14242					41.32	11993				
Anniston, Ala.	48.00*	32448*					48.00*	32448*					41.05	27750				
Lock 4, Ala.	45.41	18391					49.21	19930					41.41	16771				
Talladega, Ala.	50.08	36909					48.52	35759					34.89	25814				
Birmingham, Ala.	54.41	14364					50.54	13343					34.32	9060				
Goodwater, Ala.	51.70	62660					56.36	68308					46.03	55788				
Clanton, Ala.	48.00*	54816*					51.00*	58242*					29.48	33666				
Wetumpka, Ala	46.50	19763					52.17	22172					43.27	18390				
Newnan, Ga.	51.12	8179					47.42	7587					32.21	5154				
Rockmills, Ala.	53.00*	33072*					50.00*	31200*					40.00*	24960*				
Opelika, Ala.	70.30	35150					48.00*	24000*					43.11	21555				
Tallassee, Ala.	52.00*	42640*					48.50	39770					40.88	33522				
Union Springs, Ala.	67.17	34928					56.53	29396					41.24	21465				
Montgomery, Ala.	48.62	33402					48.99	33856					37.00	25419				
Fort Deposit, Ala.	47.32	18597					49.52	19461					38.00*	14934*				
Selma, Ala.	45.46	22275	33941			50%	47.21	23133	34431			51%	36.85	18057	14544			74%
Totals	1574.08	807624 (67302)	33941	4.12	2.08	2.04	1651.76	835624 (69635)	34431	4.27	2.11	2.16	1283.53	636252 (53021)	14544	3.25	0.83	2.42
Average	49.49						51.81						38.99					

Station	1905 Annual Rainfall Inches	1905 Rainfall Inch Miles ()=Cu.Ft.Miles	1905 Mean Discharge Sec. Feet	1905 Run-off: Rainfall, feet per Sq. Mile	1905 Run-off: Run-off, feet per Sq. Mile	1905 Run-off: Percentage of Loss	1906 Annual Rainfall Inches	1906 Rainfall Inch Miles ()=Cu.Ft.Miles	1906 Mean Discharge Sec. Feet	1906 Run-off: Rainfall, feet per Sq. Mile	1906 Run-off: Runoff, feet per Sq. Mile	1906 Run-off: Percentage of Loss	1907 Annual Rainfall Inches	1907 Rainfall Inch Miles ()=Cu.Ft.Miles	1907 Mean Discharge Sec. Feet	1907 Runoff: Rainfall, feet per Sq. Mile	1907 Runoff: Run-off, feet per Sq. Mile	1907 Runoff: Percentage of Loss
Cleveland, Tenn.	55.04	18053					57.67	18916					52.56	17240				
Dahlonega, Ga.	67.56	5743					73.28	6229					54.39	4623				
Diamond, Ga.	69.59*	30132*					69.59*	30132*					56.00	24248				
Gainsville, Ga.	46.11	3320					53.43	3842					36.29	2613				
Alpharetta, Ga.	48.12*	7218*					52.48*	7872*					42.02*	6303*				
Canton, Ga.	55.75	37910					50.36*	34245*					50.36*	34245*				
Adairville, Ga.	56.69	22676					64.96	25984					43.42	17368				
Atlanta, Ga.	42.51	4804					53.65	6062					39.43	4456				
Tallapoosa, Ga.	41.82	54575					49.80*	64989*					49.80*	64989*				
Rome, Ga.	56.03	37484					63.08	42200					43.92	29382				
Ramsey, Ga.	59.61	34037					72.04	41135					52.77	30132				
Resaca, Ga.	53.69	13798					62.71	16116					48.00*	12336*				
Greenbush, Ga.	55.28	27916					64.28	32461					50.39	25447				
Valleyhead, Ala.	53.03	13258					58.72	14680					44.61	11153				
Maple Grove, Ala.	58.86	44616					64.57	48944					52.57	39848				
Gadsden, Ala.	54.05	21458					59.22	23510					54.13	21490				
Ashville, Ala.	58.35	16922					71.02	20596					61.51	17838				
Anniston, Ala.	59.50	40222					70.83	47881					51.28	34665				
Lock 4, Ala.	52.95	21445					66.37	26880					60.40	24462				
Talladega, Ala.	60.65	44699					61.66	45443					55.58	40962				
Birmingham, Ala.	50.79	13410					64.74	18091					54.59	14412				
Goodwater, Ala.	57.36	69520					64.52	78198					53.12	64381				
Clanton, Ala.	46.00*	52532*					67.82	77440					56.58	64614				
Wetumpka, Ala	49.05	20846					52.12	22151					53.76	22848				
Newnan, Ga.	46.99	7518					57.49	9198					50.26	8042				
Rockmills, Ala.	50.00*	31200*					53.00*	33072*					51.00*	31824*				
Opelika, Ala.	53.65	26825					51.79	25895					53.47	26735				
Tallassee, Ala.	46.17	37859					53.21	43632					54.31	44534				
Union Springs, Ala.	58.72	30534					57.82	30066					60.97	31704				
Montgomery, Ala.	47.23	32447					50.13	34439					49.83	34233				
Fort Deposit, Ala.	43.36	17040					51.17	20110					56.17	22075				
Selma, Ala.	53.71	26318	25130			65%	50.00*	24500*	37368			54%	54.13	26524	30351			57%
Totals	1708.22	866335 (72195)	25130	4.42	1.54	2.88	1913.54	974909 (81242)	37368	4.98	2.29	2.69	1647.62	855726 (71311)	30351	4.37	1.86	2.51
Average	53.09						59.74						52.44					

Graphical representation for each year of Gage Heights and the Maximum and Minimum Discharges at Selma, Ala.



Vertical Scale of Discharge, 0 60000 sec. feet.

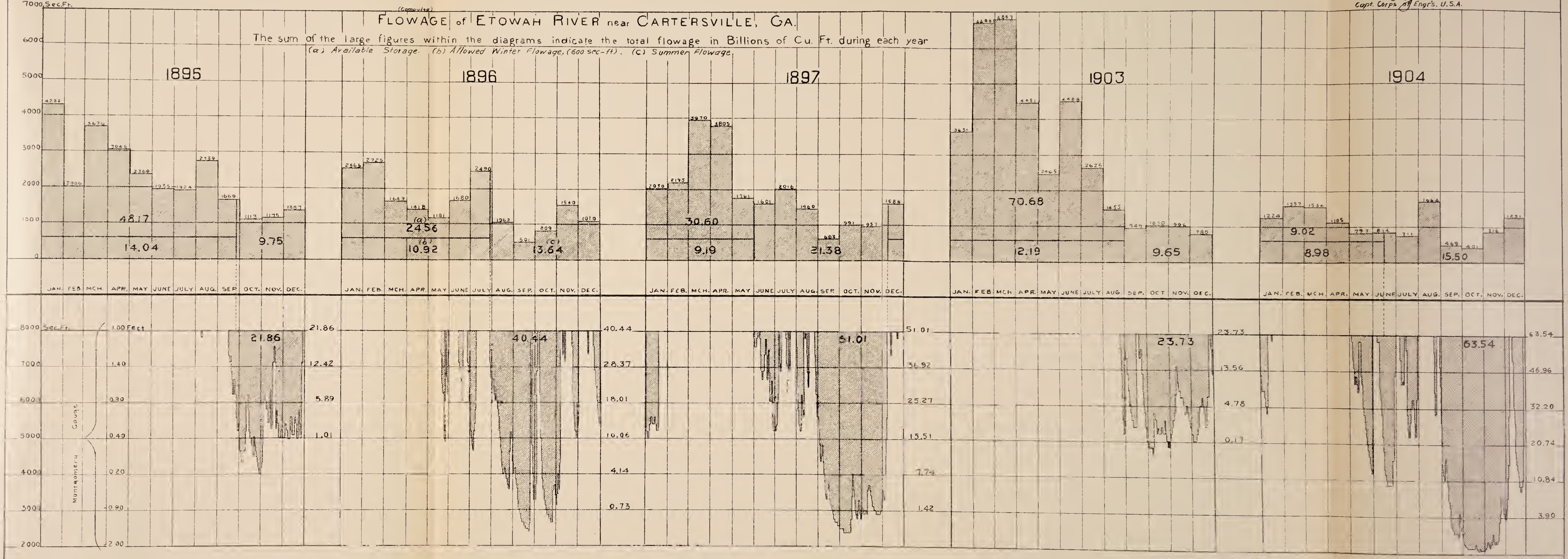
Records of previous High Water at Montgomery, Ala. —
Year 1886, Gauge Height 59 Feet.
" 1833, " " 61 "

ETOWAH, COOSA, & TALLAPOOSA RIVERS
PRELIMINARY EXAMINATION 1909.

DRAWING 1

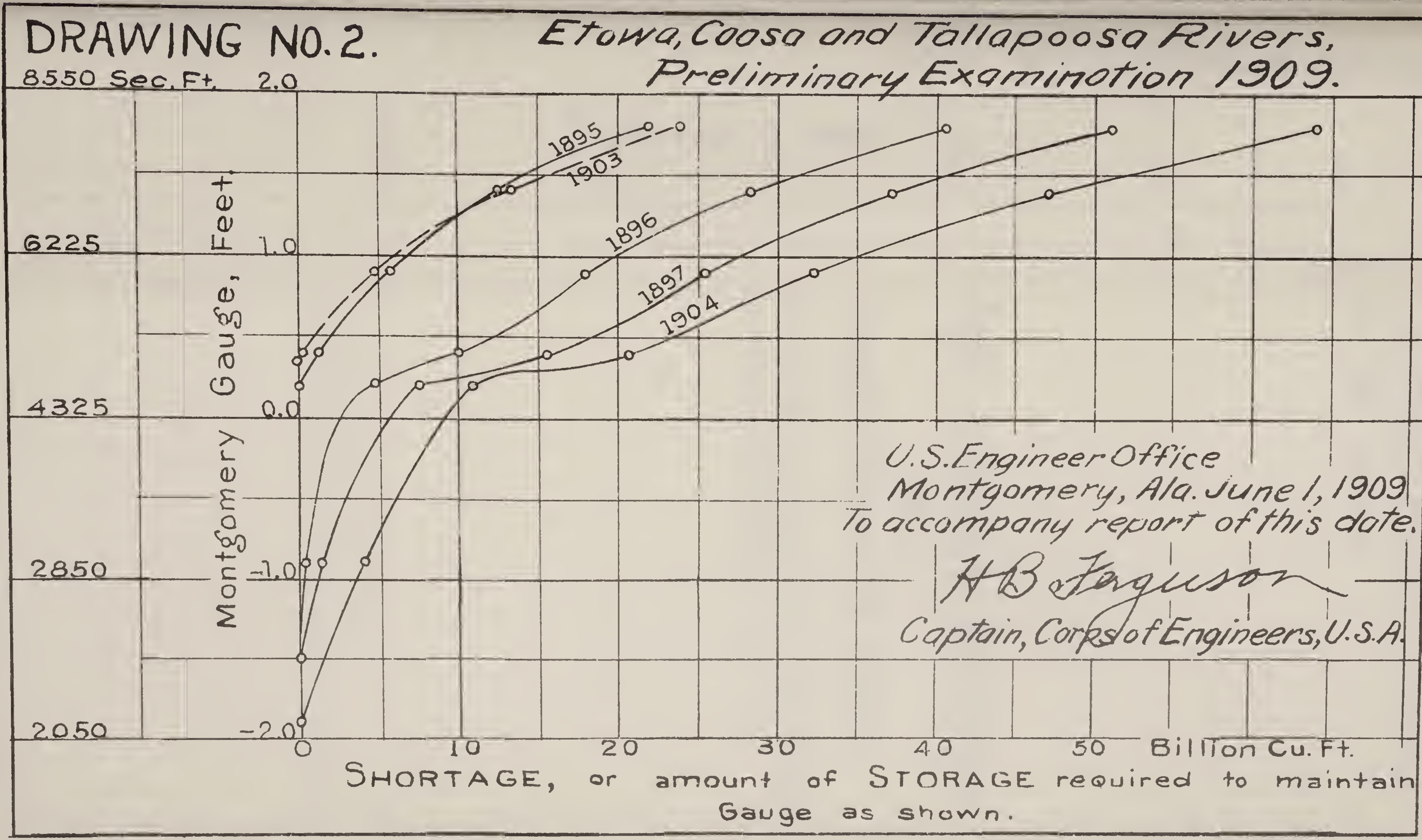
ETOWAH, COOSA, & TALLAPOOSA RIVERS
PRELIMINARY EXAMINATION 1909.

U. S. Engineer Office,
Montgomery, Ala. June 1st 1909
To accompany report of this date.
H. B. Ferguson
Capt. Corps of Engr's. U.S.A.

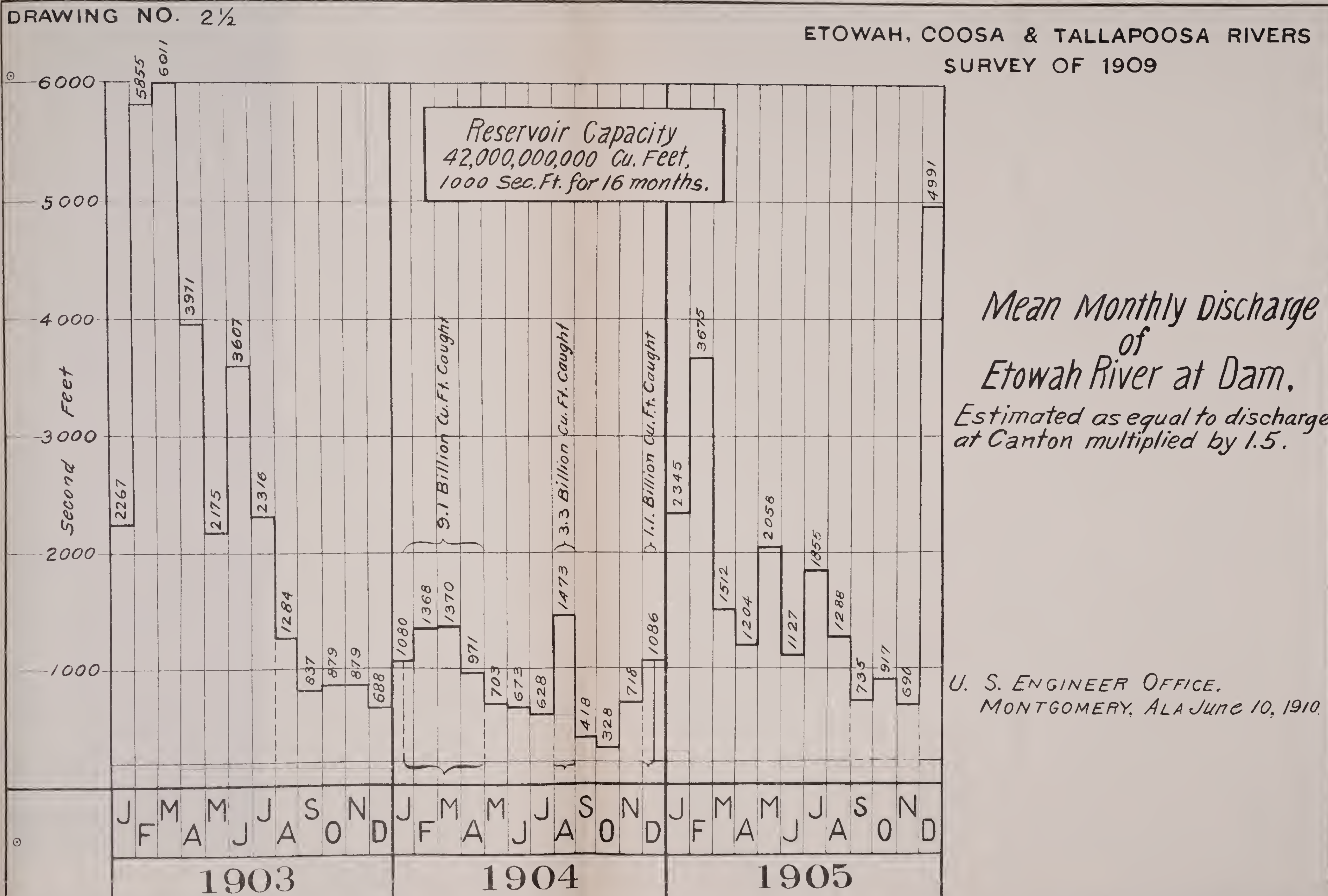


(from Records)
SHORTAGE (BELOW 8000-7000-6000-5000-4000-3000-2000) OF ALABAMA RIVER at MONTGOMERY, ALA.
The figures to the right of each Year Shortage Diagram gives in Billions of Cu. Ft. the total Shortage below 8000 sec.-ft., 7000 sec-ft. etc.

THE NORRIS PETERS CO. WASHINGTON, D. C.



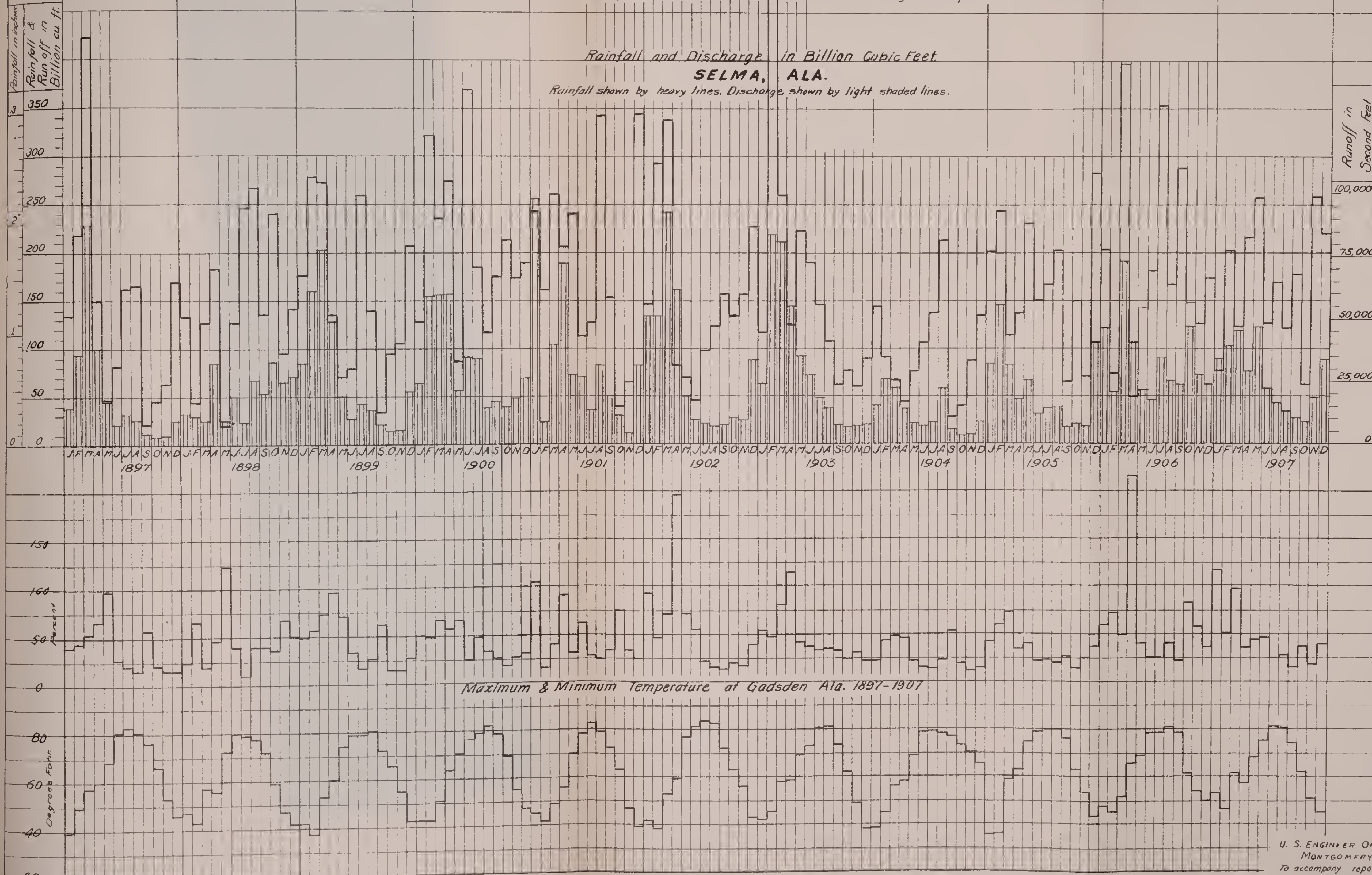
THE NORRIS PETERS CO., WASHINGTON, D. C.



House Doc. No. 253 ; 63d Cong., 1st Sess.

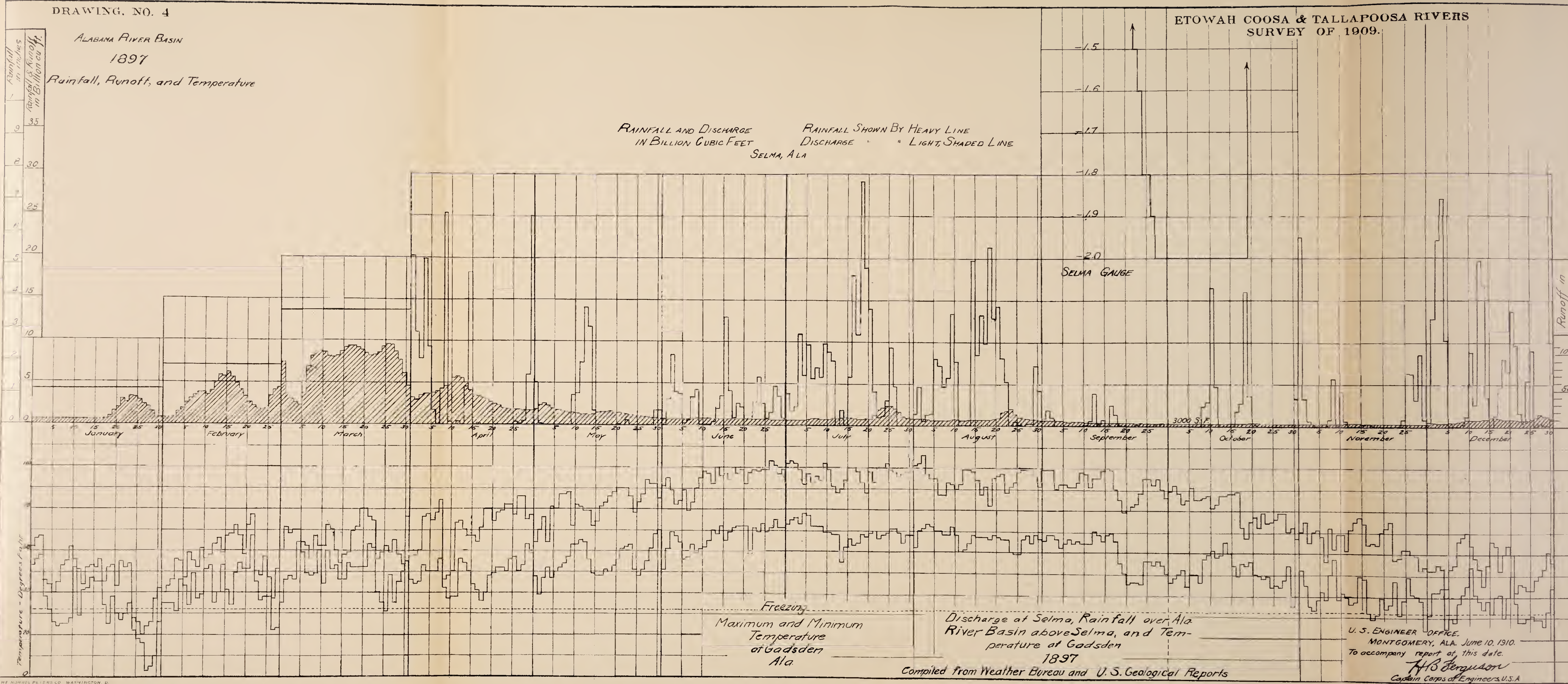
ALABAMA RIVER BASIN. RAINFALL, RUN-OFF & TEMPERATURE, 1897-1907

Compiled from Weather Bureau & U. S. Geological Reports.

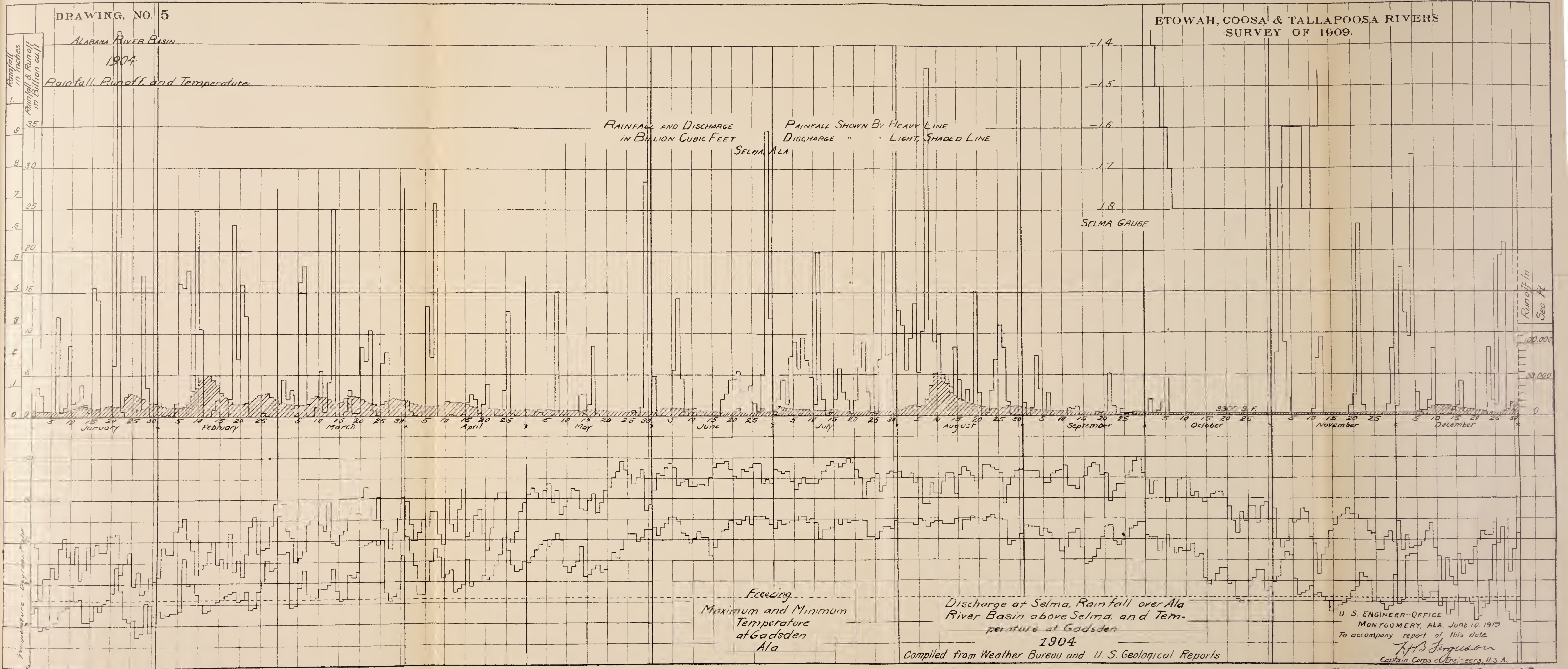


U. S. ENGINEER OFFICE,
MONTGOMERY, ALA. June 10, 1910
To accompany report of this date.
H. B. Ferguson
Captain Corps of Engineers, U. S. A.

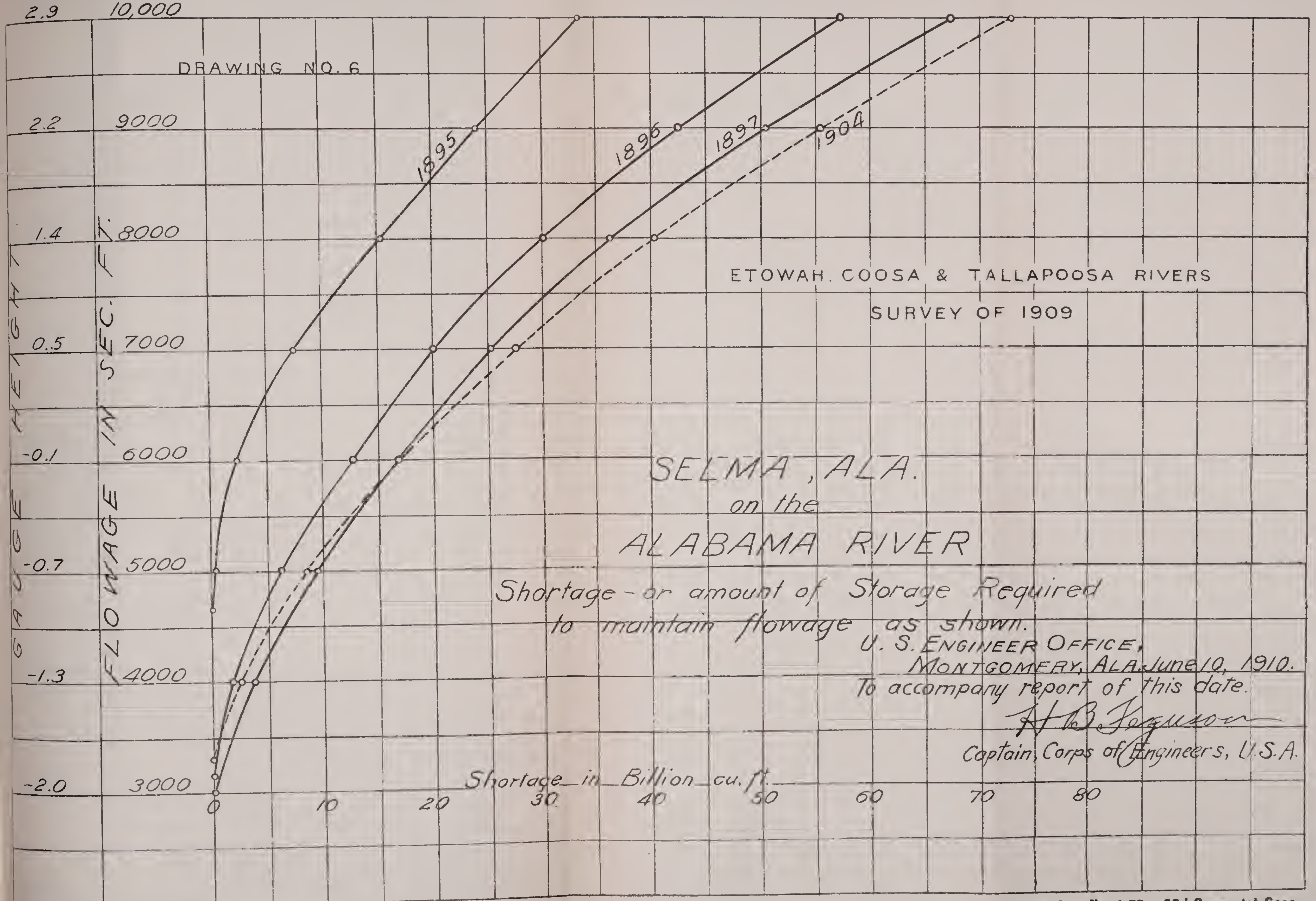
THE NORRIS PETERS CO., WASHINGTON, D. C.



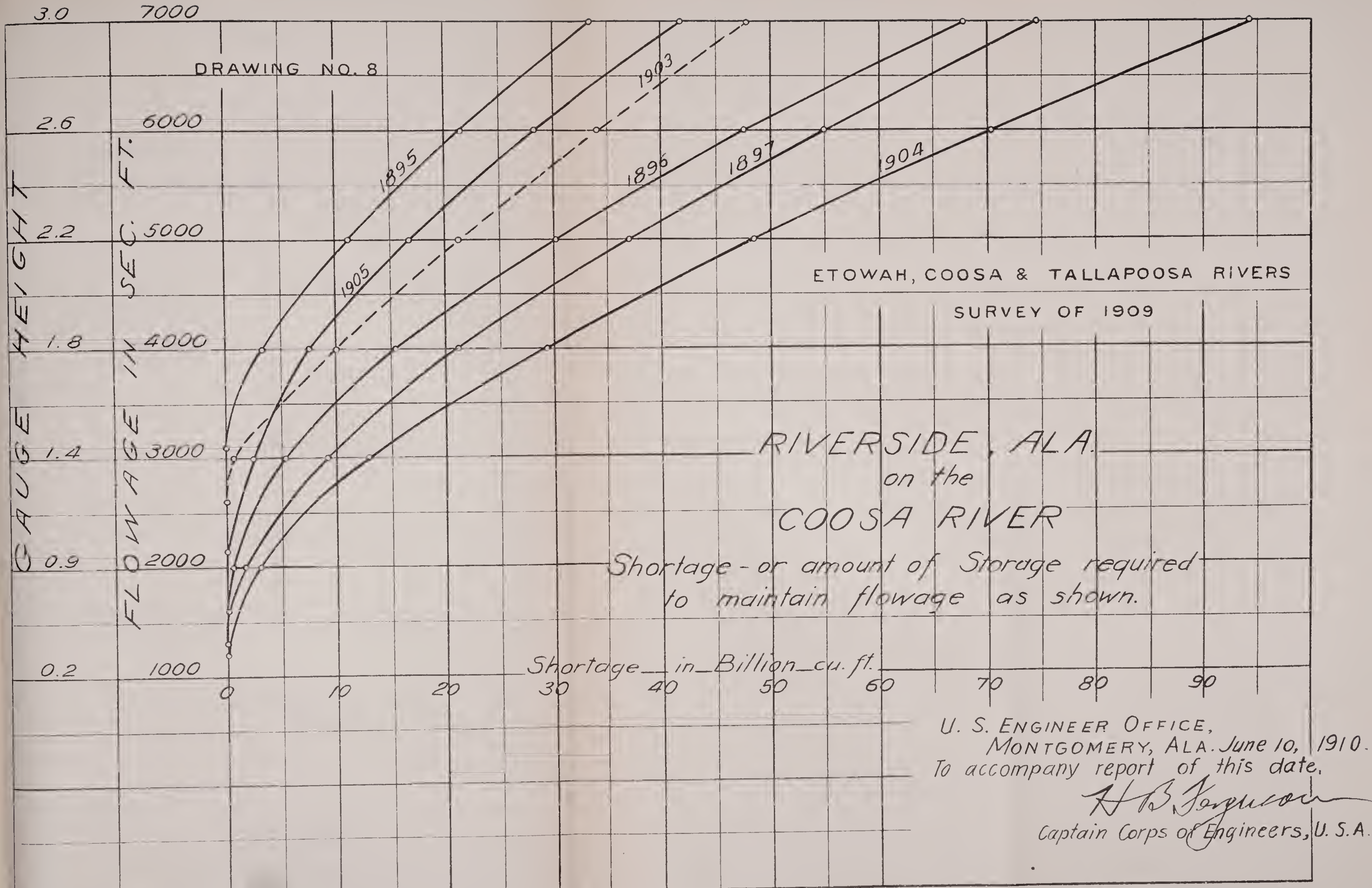
DRAWING. NO. 4
ETOWAH COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909.
Alabama River Basin
1897
Rainfall, Runoff, and Temperature
Rainfall in Inches
Rainfall & Runoff in Billion cu. ft.
Rainfall and Discharge in Billion Cubic Feet
Selma, Ala
Rainfall Shown By Heavy Line
Discharge " " Light, Shaded Line
Selma Gauge
Runoff in Second Feet
100,000
50,000
3000 S.F.
January
February
March
April
May
June
July
August
September
October
November
December
Temperature - Degrees Fahr.
Freezing
Maximum and Minimum Temperature at Gadsden Ala.
Discharge at Selma, Rainfall over Ala. River Basin above Selma, and Temperature at Gadsden
1897
Compiled from Weather Bureau and U. S. Geological Reports
U. S. Engineer Office.
Montgomery, Ala. June 10, 1910.
To accompany report of this date.
H B Ferguson
Captain Corps of Engineers U.S.A.



House Doc. No. 253 ; 63d Cong., 1st Sess.


DRAWING NO. 6
ETOWAH. COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909
SELMA, ALA.
on the
ALABAMA RIVER
Shortage - or amount of Storage Required
to maintain flowage as shown.
U. S. ENGINEER OFFICE,
MONTGOMERY, ALA. June 10, 1910.
To accompany report of this date.
H B Ferguson
Captain, Corps of Engineers, U.S.A.
GAUGE HEIGHT
FLOWAGE IN SEC. FT.
Shortage in Billion cu. ft.
1895
1896
1897
1904
2.9
2.2
1.4
0.5
-0.1
-0.7
-1.3
-2.0
10,000
9000
8000
7000
6000
5000
4000
3000
0
10
20
30
40
50
60
70
80

THE NORRIS PETERS CO., WASHINGTON, D. C.


DRAWING NO. 8
ETOWAH, COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909
RIVERSIDE, ALA.
on the
COOSA RIVER
Shortage - or amount of Storage required
to maintain flowage as shown.
GAUGE HEIGHT
FLOWAGE IN SEC. FT.
3.0
2.6
2.2
1.8
1.4
0.9
0.2
7000
6000
5000
4000
3000
2000
1000
1895
1905
1903
1896
1897
1904
Shortage in Billion cu. ft.
0
10
20
30
40
50
60
70
80
90
U. S. ENGINEER OFFICE,
MONTGOMERY, ALA. June 10, 1910.
To accompany report of this date.
H B Ferguson
Captain Corps of Engineers, U. S. A.

DRAWING, NO. 9

ETOWAH, COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909.

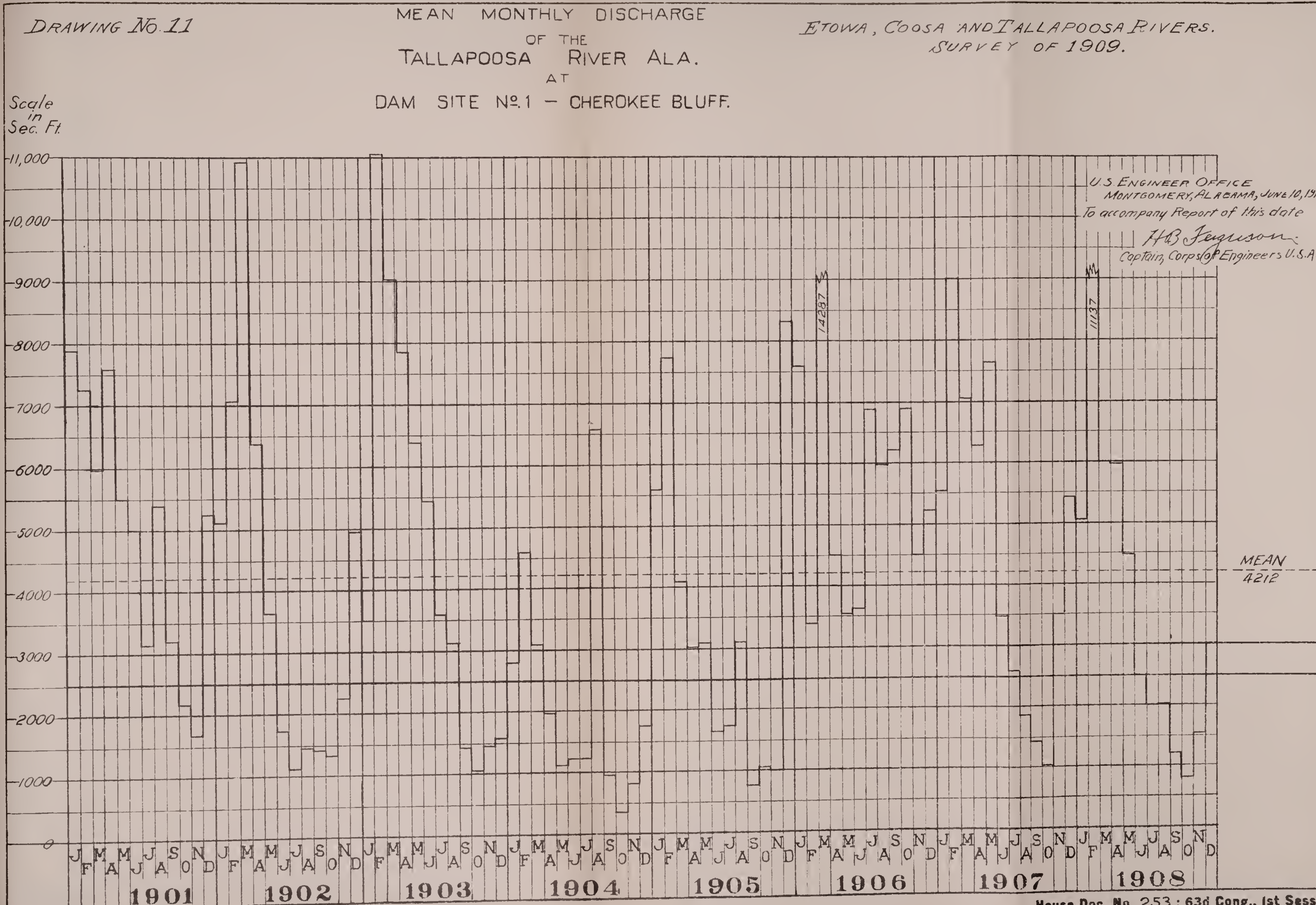
COOSA RIVER AT RIVERSIDE - 1904
STORAGE REQUIRED

Compiled From U.S. Geological & Weather Bureau Reports

U. S. ENGINEER OFFICE,
MONTGOMERY, ALA. June 10, 1910.
To accompany report of this date.
H. B. Ferguson
Captain Corps of Engineers, U.S.A.

DRAWING, NO. 10

ETOWAH, COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909.



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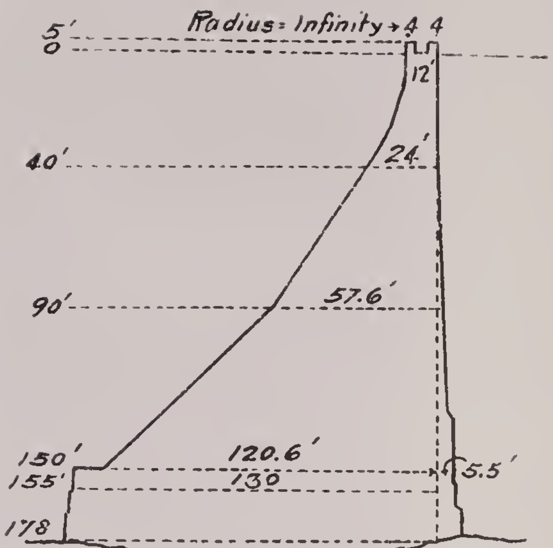
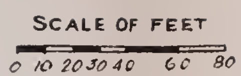
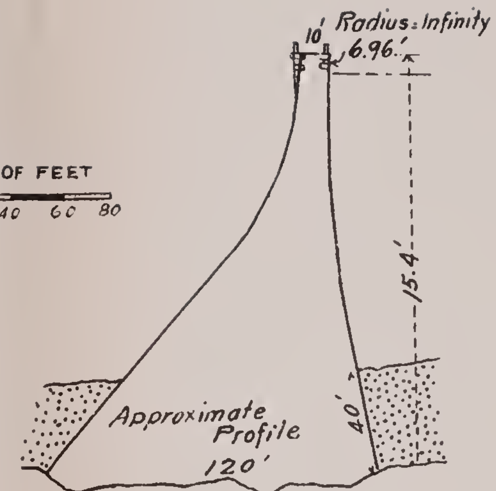
DRAWING NO. 12.

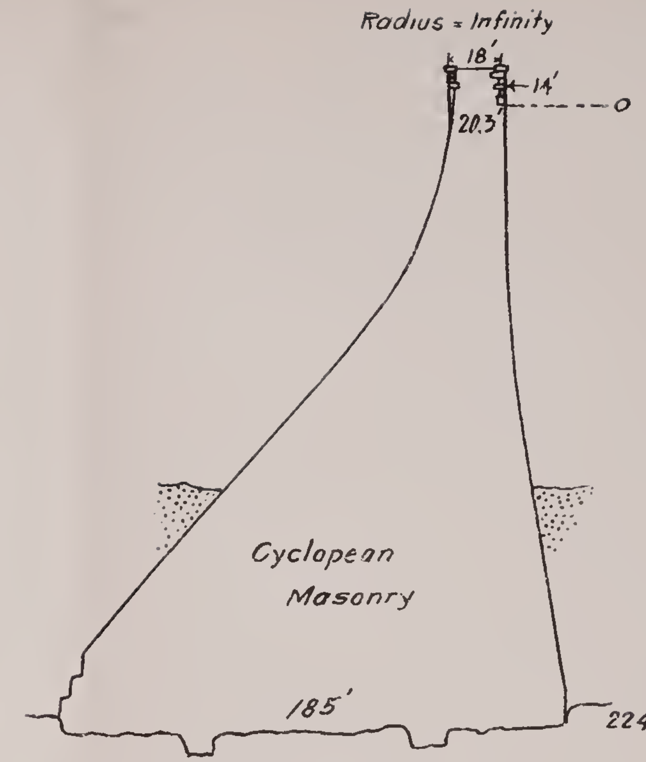


PERIYAR DAM
(India 1889-96)

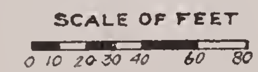


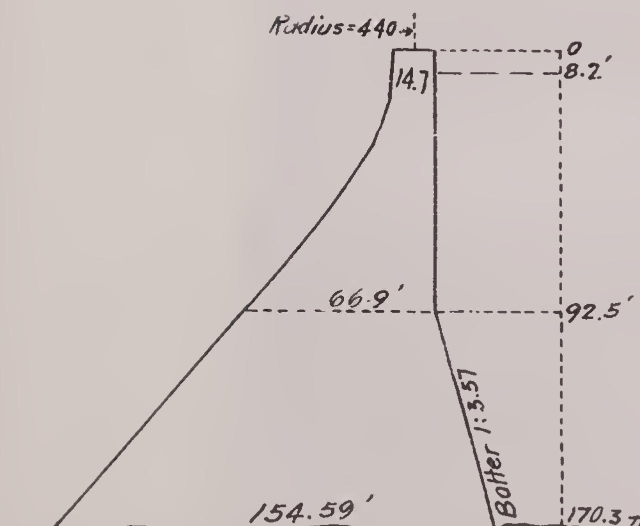


CATARACT DAM
(Australia 1902-08)

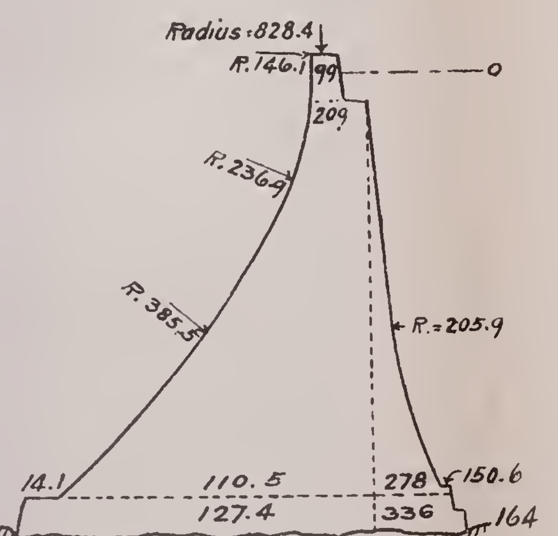


NEW CROTON DAM
(New York 1892-1907)

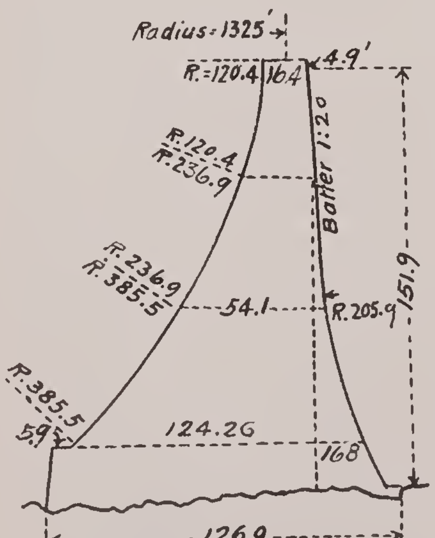




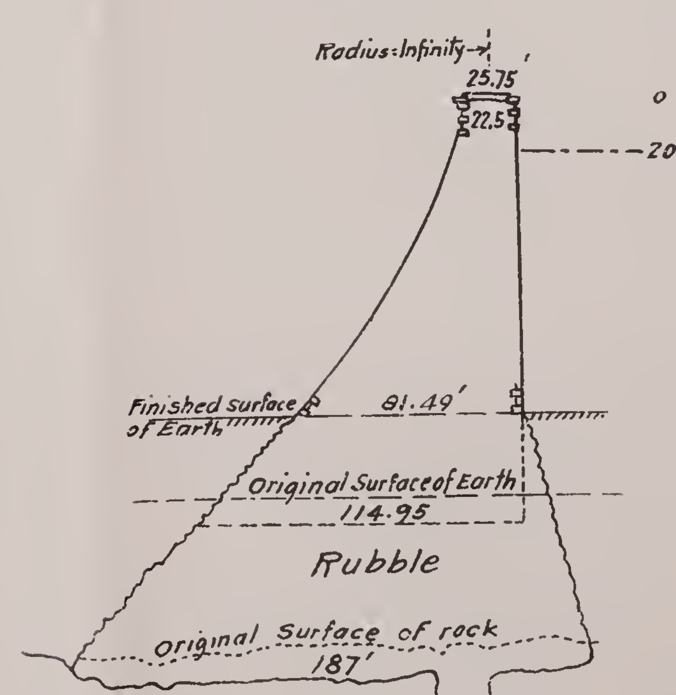
VILLAR DAM
(Spain 1870-1878)



FURENS DAM
(France 1862-1866)



BAN DAM
(France 1867-1870)



WACHUSETT DAM
(Massachusetts 1896-1906)

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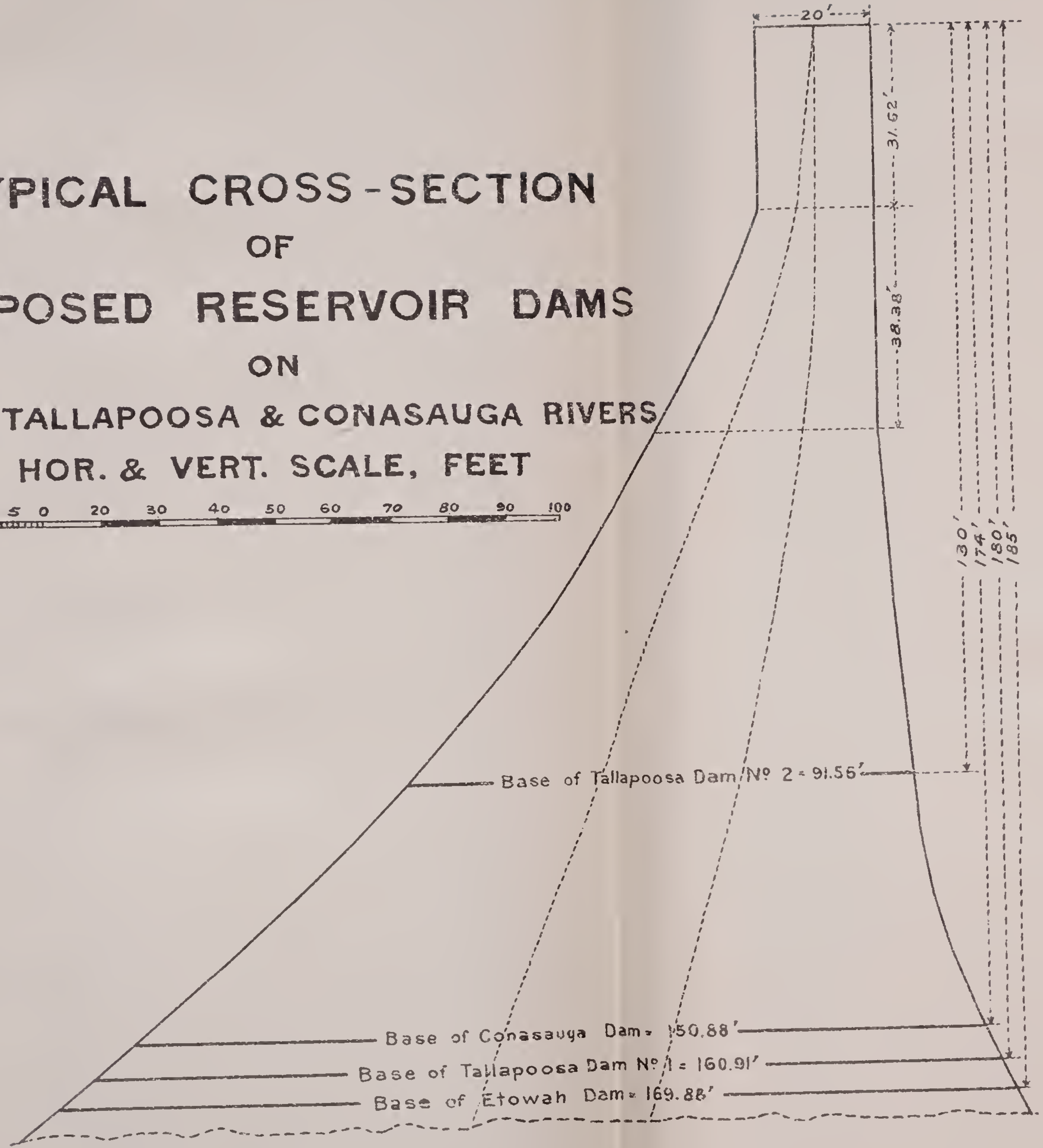
DRAWING NO. 13

ETOWAH, COOSA & TALLAPOOSA RIVERS
SURVEY OF 1909.

TYPICAL CROSS-SECTION OF PROPOSED RESERVOIR DAMS ON ETOWAH, TALLAPOOSA & CONASAUGA RIVERS

HOR. & VERT. SCALE, FEET

10 5 0 20 30 40 50 60 70 80 90 100



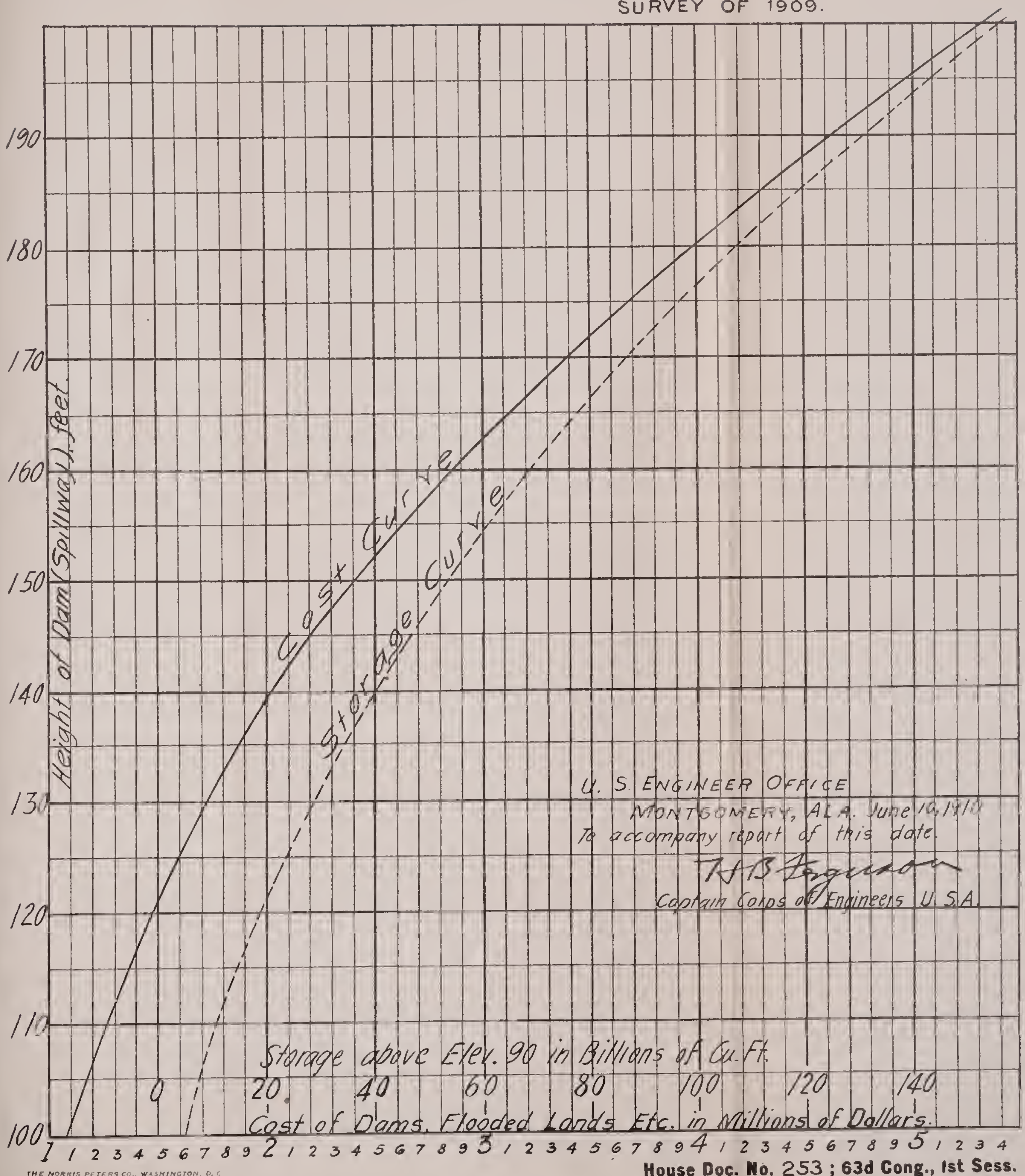
U. S. ENGINEER OFFICE
MONTGOMERY, ALA. June 10, 1910.
To accompany report of this date.

H B Ferguson
Captain Corps of Engineers, U.S.A.

House Doc. No. 253 ; 63d Cong., 1st Sess.

DRAWING NO. 14

ETOWAH, COOSA, & TALLAPOOSA RIVERS
SURVEY OF 1909.



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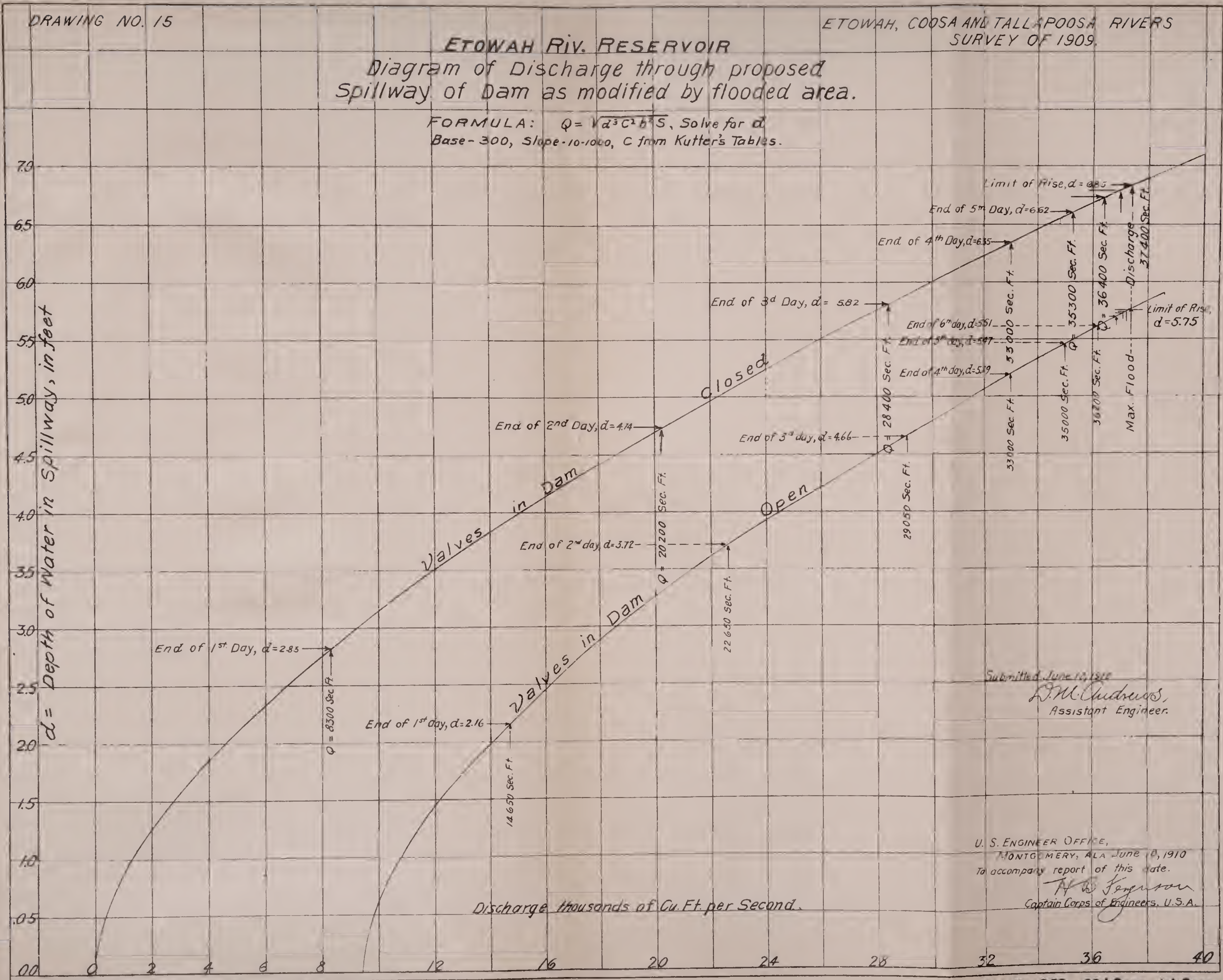

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DRAWING NO. 16

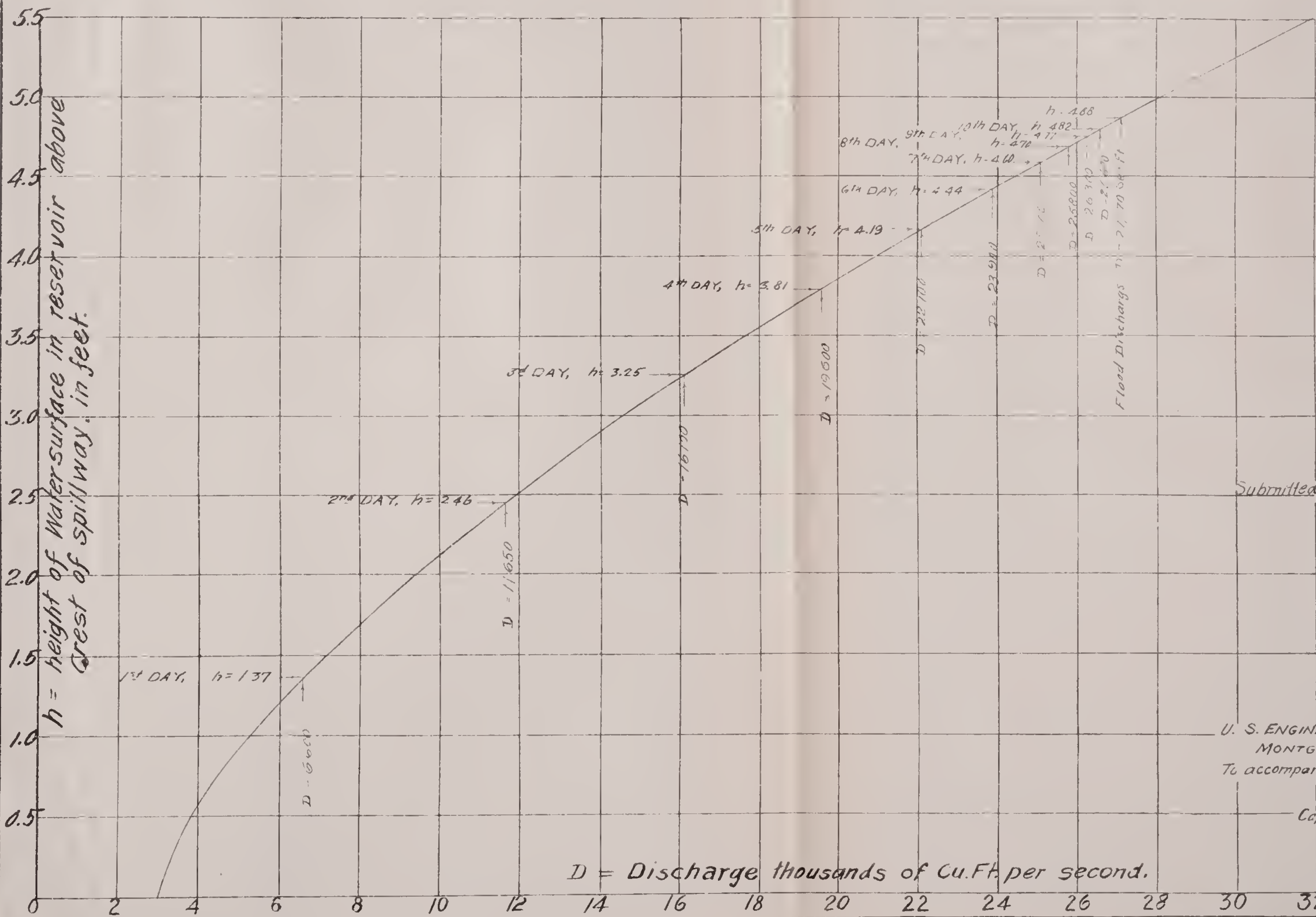
ETOWAH, COOSA AND TALLAPOOSA RIVERS.
SURVEY OF 1909.

TALLAPOOSA RIVER RESERVOIR No. 1.

Diagram showing height of pool level in reservoir above crest of spillway.

Formula: $h = \left(\frac{3/2\,Q}{0.70b\sqrt{2g}}\right)^{2/3}$

Q = discharge over weir.
3000 sec ft. continuously drawn through wheels



Submitted June 10, 1910
D. M. Andrews,
Assistant Engineer.

U. S. ENGINEER OFFICE.
MONTGOMERY, ALA June 10, 1910
To accompany report of this date
H. B. Ferguson
Captain Corps of Engineers U. S. A.

THE NORRIS PETERS CO., WASHINGTON, D. C.